SAE Journal

JANUARY 1955

IN THIS ISSUE . . .

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LITTLE THINGS MEAN A LOT—

Exclusive Goodyear Bond-a-Coat finish resists corrosion and discoloration, keeps its luster indefinitely.

in upping pay loads, too

MAYBE you've never thought of rims as a big item in your operation. Yet, you can achieve big savings if you pick the right rims.

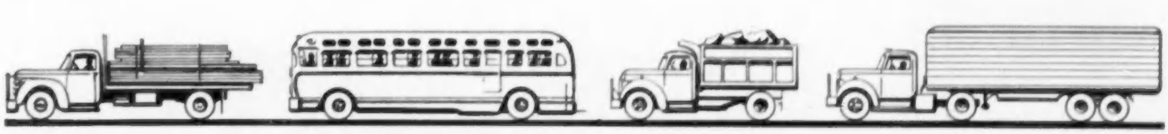
Goodyear Wide Base Rims, for example, in nearly all sizes, weigh less than standard-size wide base rims. *When you specify these lighter rims, you can haul as much as a hundred pounds' extra pay load on a tractor-trailer unit.*

Greater Tire Mileage

In addition, Goodyear Wide Base Rims give up to 30% greater tire mileage—and the service records of countless trucks and buses prove it. That's because these superior rims help to reduce sidewall flexing—resulting in less tire heat, fewer tire failures and road delays.

Cost Less To Start With

And here's the real pay-off: *even their initial cost is lower!* Check the whole story on these important economies with your Goodyear Rim Supplier. Or write Goodyear, Metal Products Division, Akron 16, Ohio

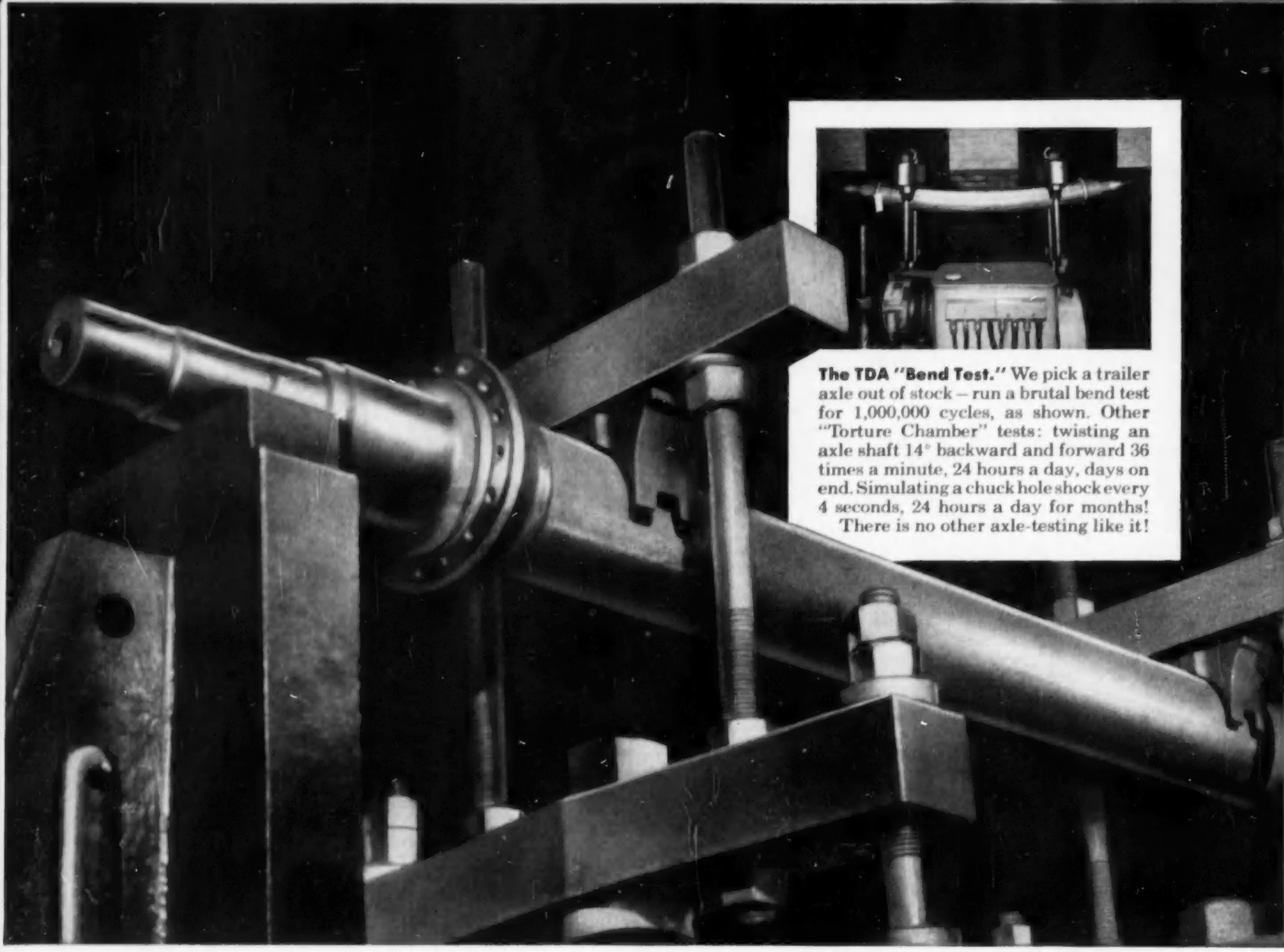


GOODYEAR

WIDE BASE RIMS

MORE TONS ARE CARRIED ON GOODYEAR RIMS THAN ON ANY OTHER KIND

We think you'll like "THE GREATEST STORY EVER TOLD"—every Sunday—ABC Radio Network—THE GOODYEAR TELEVISION PLAYHOUSE—every other Sunday—NBC TV Network



The TDA "Bend Test." We pick a trailer axle out of stock – run a brutal bend test for 1,000,000 cycles, as shown. Other "Torture Chamber" tests: twisting an axle shaft 14° backward and forward 36 times a minute, 24 hours a day, days on end. Simulating a chuck hole shock every 4 seconds, 24 hours a day for months! There is no other axle-testing like it!

WE BEND A TRAILER

in the famous, one-and-only indoor proving ground!

There's nothing else like it! To insure greater safety on the highway, we twist, smash, jerk and overload axles. Match every possible operating condition!

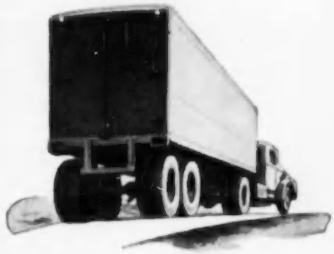
Only TDA has it! And this murderous beating proves *in advance*, that a TDA axle can really take it on the job!

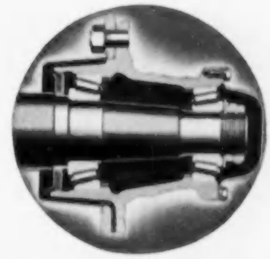
The TDA "Torture Chamber" is a multi-thousand-acre proving ground condensed into one room. In it, our engineers can give axles "the business" – put over 50 years' experience to work for you – experience gained in building axles for trucks, buses, trailers, farm machinery. Subject stock axles and gearing *indoors* to any *outdoor* operating condition – under scientific control and analysis.

The result is greater highway safety, longer axle life, less maintenance, repairs and downtime; lower operating costs. No wonder Timken-Detroit axles are the choice of leading manufacturers and operators.

Manufactured in the world's largest, most modern trailer axle plant at Kenton, Ohio. Staffed by highly trained technicians . . . backed by over 50 years of TDA engineering experience. You are cordially invited to visit us at any time.

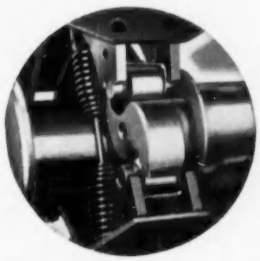
No wonder all leading trailer manufacturers and operators
Specify Timken-Detroit Axles and Brakes!

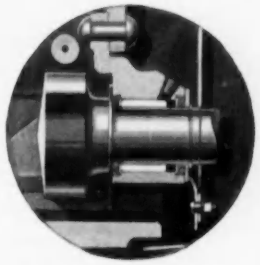


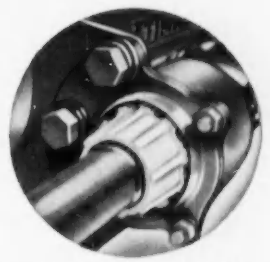


Timken-Detroit trailer axles are lighter in weight to give the greatest possible pay load. Timken-Detroit trailer axle and brake assemblies are proved far stronger, more rugged, yet safer in "Torture Chamber" tests. Timken-Detroit proven, pressed steel brake shoes save many pounds per axle over old fashioned heavy cast shoes.

TDA forged alloy steel spindle, electrically welded to seamless tube. Brake mounting flange forged integral with spindle. Checked constantly for quality.







TDA cam roller mountings will never seize. Roller will not brinell in camshaft. Note clean finish . . . heavy stamped steel straddle support for positive action . . . long life.

Cutaway view shows cam mounted in new nylon bushing. Minimum wear even when bushings are inadequately or improperly lubricated. Cannot rust, corrode or flatten out. Save weight.

TDA self-aligning camshaft support bracket. Spherical support for instant alignment during assembly or replacement. Nylon camshaft bushings wear up to 4 times as long.

AXLE 1,000,000 TIMES

Timken-Detroit

TIMKEN Detroit AXLES
TIMKEN DETROIT AXLE DIVISION
ROCKWELL SPRING AND AXLE COMPANY
DETROIT 32, MICHIGAN

The Accepted TDA Co Standard
TRADE MARK REGISTERED

"TORTURE-TESTED"
For Safety on the Highway

All leading Trailer manufacturers and operators specify Timken-Detroit safety-tested, quality built axles and brakes

Exclusive ¾" TDA "Econoliner" brake liners. Thickest at center where greatest wear occurs. Taper down at ends. Held rigidly by 12 deep set rivets per block. Spider riveted to flange. New design decreases operating temperatures, increases safety, cuts down excessive wear.

For the Sake of Argument

A Young Man's View . . .

By Norman G. Shidle

"I've decided I'm being paid to keep little problems from getting up too high," a junior engineering executive told us the other day.

"It took me several years to figure this out. For quite a while I suffered under the delusion I was being paid just to work."

In response to a prompt: "Tell us more", additional ideas came tumbling out.

"Steady observation of what happens to problems when they get 'upstairs' ", the young man continued, "gave me my first tipoff. Watching, I found that big executives work only on big problems. No matter how small the problem when it starts 'upstairs', it has to become big in process of 'upstairs' consideration.

"I became frightened when I got to estimating the dollars-per-minute that were spent on some of the little ones I went 'upstairs' with. Then it dawned on me! The only way I can really save the company's money is to knock off the little ones at my own level—where it doesn't cost so much to handle them.

"Now I do my best to handle both people and problems of any size within the limits of company policies as far as I know them. . . . And I'm just a little amazed at how many I can handle—without backfires. Besides, my boss likes it. He hasn't said anything directly, but I can tell. He likes it."

It has been a good many years since we or any of our cronies have been young executives. So these comments came as a combination of "see-yourself-as-others-see-you" and "how-the-other-half-lives."

Result: our eyes opened quite wide!

SAE JOURNAL

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Managing Editor

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1905 GOLDEN ANNIVERSARY 1955

Contents—January, 1955

President's Message . . .

1954 SAE President William Littlewood

A year's experience as President of SAE has given me an ever-increasing understanding and appreciation of the breadth and strength of the Society.

As I have traveled about and met with the members at National and Section meetings, there has been impressed upon me the completeness and diversification of automotive engineering as represented by them in the affairs and activities of SAE. It is certainly true that the Society deals with all aspects of automotive engineering on the ground and in the air; and sometimes on and under the sea. I have not been surprised, therefore, to find all types of engineers working together in SAE—to their own and their profession's benefit, and to the great good of their industries and their country.

My conviction has grown throughout the year that the strength of SAE lies in the quality of its membership far more than in its ever-growing numbers, and in the active participation of these members in the technical and fraternal exchanges which characterize committee and meeting work. And most importantly, its strength lies in the devoted and competent functioning of the Society's permanent staffs at headquarters in New York, in Detroit, on the West Coast, and wherever you may find their representatives working behind the scenes at meetings and Society affairs.

It has been easy to recognize the basic importance of our Sections and their work. These geographically identified centers of the Society's functioning, giving more emphasis to the broad scope of automotive engineering interests than to the specialized technical matters handled so effectively by the Activity groups, are truly centers of strength of the Society's membership. They combine local technical activities and interests with the fraternal and personal relationships which are just as necessary in engineering as in all walks of life. They are the backbone of SAE, since from them come not only the strong cooperative engineering spirit which prevails but also the expert talent and technical capacity which is abstracted from each to be devoted on a national basis to the specialized works of the various Activities.

It is to and for all members of SAE that the objectives and benefits of the Society are directed. The assets are acquired or created and distributed solely for their interest and benefit as engineers. My special thanks goes to the Finance Committee which has so devotedly and effectively administered our financial affairs during the past year. My great appreciation also goes to the Technical Board and all those engaged in its supervised activities who continue to make such signal contributions to the technical welfare of our automotive industries and to our country.

We are justly proud of our widely distributed and recognized SAE publications. All who have had a part in those ventures can derive great satisfaction from their accomplishments and technical contributions.

I would like to thank all committees everywhere, and all who have worked on them—from the Atlantic to Hawaii, and from Mexico to Hudson Bay. Their work has been essential to the overall functioning and accomplishments of SAE for 1954.

And I wish particularly, in closing, to thank all members of the Society for their patient understanding and support throughout the year. It has all added up to a wonderful and rewarding experience as your President. I am proud to pass on our 1954 record to my successor.

1954 Annual Report

SAE Council in 1954 approved the inauguration of a number of new projects. Its actions also stamped the completion of scores of constructive programs in every area of the Society's activity.

During this year, two new SAE-sponsored awards came to fruition. The first L. Ray Buckendale Lecturer and the first winner of the Russell S. Springer Award were named in 1954. Numerous new technical committee projects in the service of industry were started. New procedures made it easier for Enrolled Students to come into membership at the end of their academic career.

Completion of the Society's program for celebration of its 50th Anniversary in 1955 was achieved as

T. L. Swansen
Chairman
Constitution Committee

W. M. Walworth
Chairman
Technical Board

H. E. Chesebrough
Chairman
Meetings Committee

T. B. Rendel
Chairman
Publication Committee

M. A. Thorne
Chairman
Public Relations Committee

1954 ended, and a variety of specific projects was finished by almost every one of the Society's committees on which the Council relies. Many of these 1954 achievements are high-spotted in the pages that follow.

Technical Committees Complete Many Projects

Projects of primary interest to industry continued to be of major importance in the Society's technical committee work, although numerous important advisory services were rendered to various government agencies.

In the motor vehicle field, standards for the new Sealed Beam headlighting units were adopted. These new units are currently being made available in some states for replacement but will not be installed on new cars until mid-1955. Other developments affecting lighting are new recommended practices for transparent plastics used in lenses and reflectors, and for headlamp beam switching devices.

An aeronautical recommended practice has been developed covering a universal maintenance and overhaul stand for turbo-engines in the 10,000 lb thrust class. This recommended practice was developed in response to a request from the military for a field overhaul stand of the roll-over type which would handle present high-thrust powerplants as well as new engines on the drawing board.

Two new projects of major importance have been launched by the Aeronautics Committee. One involves study of technical problems in the use of thermocouples and related equipment with standards as the ultimate objective. The other is coordinating the work on "O" ring problems as they arise in other aeronautical technical committees.

Activities continue at high levels on aeronautical material specifications and engine and propeller utility parts. In the field of hydraulic equipment for aircraft, in addition to work on military specifications, a symposium was held on static seals at which all types of seals used in temperatures from – 65 F to 1500 F and from 0 to 4000 psi were reviewed. New specifications for electrical cable and for synchros have been under development and it is hoped that these will replace numerous documents now in use.

In the instrument field, a minimum safety performance standard has been developed for flight directors which will permit certification of the instruments as a unit rather than requiring certification as installed in the plane.

A joint subcommittee of the Aeronautic and Automotive Drafting Committees has been working aggressively on the development of recommendations on positional and geometrical tolerances. These recommendations in addition to offering guidance within the SAE area also provide a basis for participation by the Society in national and international standardization work.

The Iron and Steel Technical Committee has submitted a report to Army Ordnance on the Machinability of Steels. Recommendations on the winteriza-

tion of earthmoving and other heavy mobile machinery used by the Engineer Corps have been developed by the Construction and Industrial Machinery Technical Committee. A report developed by the Transportation and Maintenance Technical Committee on maintenance of ground vehicles at air bases, has been transmitted to the Air Force.

Other important achievements during the past year include the completion of a blast cleaning manual which is a companion to the previously published manual on shot peening; a new automotive seating manual; a standard bracket for the new safety lamp for farm equipment; revisions in the Recommended Practice for tractor and implement disc wheels; extensive revisions in the standards for non-ferrous metals; revision of the cable terminal standard; a new standard for thermoplastic insulated low tension lighting cable; a new recommended practice providing vehicle dimension data for designing loading docks; modifications in the dry-seal pipe thread standard and revision of the SAE Commercial Vehicle Nomenclature as well as numerous others. The Engine Committee has initiated a new project on small air-cooled gasoline engines.

In addition to approving a considerable number of standards developed by ASA Sectional Committees which the Society sponsors, a standard on Refrigeration Flare Type Fittings has been submitted to the American Standards Association for approval as an American Standard under the "Existing Standards Method." The ASA has approved this Standard and has assigned it the number B70.1, 1954. This is the first time that the SAE has used the ASA "Existing Standards Method." ASA has given the Society proprietary sponsorship for this Standard which means that SAE will be responsible for keeping it up to date.

During the year, the staff has provided secretarial service for the brake and lighting subcommittees of the National Committee on Uniform Traffic Laws and Ordinances and for the chassis subcommittee of ASA Sectional Committee D7 on Motor Vehicle Inspection Requirements. Secretarial work carried on by the staff since before the war on the Advisory Committee to the Bureau of Public Roads on Brake Research has been completed.

Sections and Groups Have An Active Year

SAE Sections and Groups have had an active year. Meetings have been planned to stimulate interest of local members and as a result overall attendance continued its upward swing during 1954. The quality of meetings, combined with work of membership committees and plant representatives, has resulted in an increasing flow of applications for membership.

Several Sections, during 1954, sponsored one- and two-day specialized technical meetings, attracting attendance from wide areas. Others have been hosts to National Meetings, cooperating with sponsoring Activity Committees in making them successful.

Sections and Groups are cooperating with local

R. R. Faller
Chairman
Student Committee

H. L. Hemmingway
Chairman
Placement Committee

A. T. Colwell
Chairman
Finance Committee

Leonard Raymond
Chairman
Sections Committee

Vincent Ayres
Chairman
Membership Committee

SAE student organizations and arranging special meetings and events for Enrolled Students.

More consideration is being given to groups of members in centers within Section territory, but situated beyond convenient travel distance to regular meetings. Special meetings are being held in these areas, and where sufficient numbers of members are centered, local divisions have been organized.

SAE's newest unit is the SAE Alberta Group which makes its headquarters in Calgary. Organized informally for several years, the Council in June recognized the local organization as a Group. SAE Groups now number 6; Sections 37.

Membership Trend Continues Upward

For the fifth consecutive year the Society posted a new record high for membership—with another record in sight for 1955. Active membership totaled 19,557 at the close of the 1953-1954 fiscal year, an increase of 7% over the previous September 30. During the year there were 2495 additions to membership against losses totaling 1218; a net increase of 1277 members. The number of inactive, or Reserve Members, was reduced from 707 to 609.

The following table shows a comparative breakdown of active membership by grades as of September 30, 1953 and 1954.

	1953	1954
Member	10479	11271
Associate	4664	4858
Junior	3135	3428
Total	18278	19557

Membership applications set a new high for a fiscal year, 2793, with 387 applications in September shattering all records for a single month.

A change in the method of transition from student enrollment to membership, by which the extra year of enrollment was eliminated, resulted in a greater than normal number of applications from former students.

Life Membership

By Council action, SAE Life Memberships may be purchased by any member who has reached his 60th birthday and who, by age 65, will have completed at least 25 years of paid membership. The Life Membership fees, based upon age, take into consideration that dues are reduced to $10 per year for members 65 years of age or over who have completed at least 25 years of active membership.

Long-Time Members

Recognition certificates have been prepared for 61 members who last year completed 35 years and for 155 who completed 25 years of active membership. Sections and Groups are cooperating with the Council in the presentation of these certificates. Approximately 1700 members can boast of more than 25 years of active membership.

Meetings Grow With Expanding Society

To meet the needs of our expanding Society, virtually every phase of SAE National Meetings grew during 1954.

Total registration of 15,400 for eleven 1954 meetings just topped the previous record for twelve 1953 meetings.

Three meetings set new attendance marks—the 1954 Annual, Tractor and Los Angeles Aeronautic Meetings. The Annual Meeting mark of 5,322 makes it the biggest SAE meeting ever held. This record was made possible by successful spreading of the meeting for the first time between the Sheraton-Cadillac and Statler Hotels, thus relieving the congestion previously experienced.

Attendance at the four Production Forums held as part of the National Production, Tractor, and New York and Los Angeles Aeronautic Meetings, also set a new record of 3,400. The number of production engineers participating in the 1954 Los Angeles Aircraft Production Forum exceeded 1,500—the largest of all SAE Forums.

Each of the three Engineering Displays, held regularly in conjunction with the Annual and the New York and Los Angeles Aeronautic Meetings, set a new high for attendance, number of booths, and income.

All other sources of Meetings income hit new tops—registration, preprint sales, and dinners. The 242 papers presented at the eleven National Meetings during 1954 exceeded all previous marks. In addition, Production Forums and Round Tables produced more summary reports than ever—over 60 of them.

A new method of financing the SAE Summer Meeting by means of registration fees was introduced successfully in 1954. The 1954 Transportation Meeting was featured by the exceptional hospitality of the SAE New England Section which sponsored an unusual number of special events and entertainment to celebrate the first SAE National Meeting held in Boston since 1928.

Publications Move Ahead on All Fronts

Continued effort toward improved publication services went forward during 1954 under the leadership of the Publication Committee.

SAE JOURNAL laid increased emphasis on development of feature articles based on work of SAE technical committees; and completed the procurement and handling of the twelve special articles for its Golden Anniversary issue in February, 1955.

For SAE Journal, also, an improved cover design

was adopted during the year and a special cover for the Golden Anniversary issue developed. Greater attention than ever before was given in SAE Journal to coverage of the activities of the Society and its members. One-third of its total editorial pages were devoted to such material in 1954.

Methods for increasingly active participation by members of Readers Committees in advising and influencing SAE Journal articles were improved during the year. Also, the first complete year of official participation in Readers Committees by Juniors established firmly the desirability and feasibility of such participation.

SAE TRANSACTIONS added a Table of Contents at the front of the volume in 1954, in addition to its usual complete Index at the back. The 1954 volume contained 656 pages and incorporated 53 full-length papers. It was in the mails on August 6th, several weeks ahead of schedule.

SAE HANDBOOK again increased in size, totalling 1096 pages as compared to the previous high of 1032 in 1953. The 1955 (Golden Anniversary) issue, for which most material is compiled in 1954, bids fair to be even larger. In 1954, 19 new standards were added, and 61 were revised.

SPECIAL PUBLICATIONS added 21 new titles to its list in 1954. These special publications are chiefly reports growing out of SAE technical committee activity. The list of currently available special publications now totals more than 100. (Special Publications also distributes multilithographed copies of meetings papers by mail before and after each meeting.)

Total volume of SP sales in 1954 ran to $35,077, a little less than 1953's $41,567. Number of pieces distributed, however, rose from 113,453 to 136,320.

New Student Branches Increase Total To 51

Approval of SAE Student Branches at Southern Methodist University and Pennsylvania Military College brings the total number of approved student organizations to 51. Informal student clubs at several other schools are working toward recognition as Student Branches.

Student enrollment of the Society was 4307 at the close of the fical year, as compared with 4537 the previous year. It is anticipated that the enrollment at schools will increase during the coming year, but that there will be a drop in the overall enrollment figure due to a change in policy which eliminates the extra year of enrollment following graduation. This extra year was discontinued by Council action to bring the students more quickly into regular membership following graduation. The new policy provides uniform first year dues of $10.00 for former enrolled students elected to membership, provided that certain requirements are met. Also, initiation fees are waived for former enrolled students meeting these requiremnts. This new policy has been well received during its first year of operation.

Cooperation between Faculty Advisers, Student Branch Officers and Section and Group Student Committees continues to result in progressively better Student Branch meetings, increased student attendance at Section and Group meetings, and a growing percentage of enrolled students continuing into Society membership following graduation.

Public Relations Operates Emblem Contest

Completion of the Golden Anniversary Emblem Contest was the most important special activity of the Public Relations Committee in 1954.

From designs submitted by SAE members and SAE Enrolled Students, the Committee selected a winning emblem which will be used officially by the Society in decorations, printed matter, and other displays during celebration of the Golden Anniversary during 1955.

Under direction of policies recently reviewed by the Public Relations Committee, contacts with the press have been maintained and publicity material distributed regularly throughout the year. At each National Meeting, a member of the local SAE Section, representing the Chairman of the Public Relations Committee, has acted as host and advisor to the local press.

Placement Service Continues Active

The Placement Service has continued to fill a need for SAE members and enrolled students.

450 prospective employers receive the "Men Available" bulletins. Actual job listings show many more openings than there are men to fill them. Furthermore, these openings are kept "live" through postal cards which require positive company action to maintain a listing.

Of primary importance to the success of the Service are the Placement Chairmen of SAE Sections and Groups in their personal efforts to assist their associates.

Since the 1947 revision of procedures, there has been little need for change. Despite this, a January meeting of the Placement Committee Executive Committee is taking another look.

Grading Committee Has Another Active Year

The past fiscal year was a busy one for the Membership Grading Committee. It reviewed 2345 original applications for membership and 372 applications for transfer of grade, and made recommendations on each for the Council's consideration. Of the applications reviewed, only 45 candidates

B. B. Bachman
Treasurer

were not considered eligible for membership. Most of these were young men whose training and experience were not considered sufficient to qualify them for membership.

The Membership Grading Committee meets before each Council meeting to review special cases which are pending at that time. Most of the work of the committee is conducted by letter ballot.

Besides reviewing applications for membership and transfer, the Committee makes recommendations, for Council action, as to schools from which the Society may accept students as SAE Enrolled Students. The basic criteria is that graduates from these schools should have sufficient engineering training to qualify them to take subordinate engineering positions, one of the qualifications for Junior grade of membership. During the past year, seven schools were considered by the Committee, of which four were approved for Student Enrollment.

The Treasurer Looks at Dollars

The Society's audited figures are presented here and supplemented by a chart of income and outgo.

The Society is currently operating on an annual budget of $1,500,000. Principal sources of revenue to meet the expenditures are members' dues and fees of over $480,000, and advertising revenues close to $470,000. These are supplemented by substantial revenues received through the sale of publications. Funds from industry to support the Technical Board operations, and other miscellaneous items, bring total revenues somewhat higher than expenditures.

Current Status

The Finance Committee, including the Treasurer, still has the goal for reserves equal to one year's expenditures. However, the increase in both income and expense continues to move the goal farther ahead. Nevertheless, the reserve situation seems sufficiently strong to make it undesirable to curtail

Balance Sheet

at September 30, 1954

ASSETS

Cash—Unrestricted		$ 327,952.61
Restricted		22,881.62
Notes & Accounts Receivable—Less Reserves		13,387.84
U. S. Gov't Bonds		495,310.98x
Preferred & Common Stocks & $57.01 Cash in Investment Advisory a/c		210,159.10x
Accrued Interest on Bonds		3,418.03
Inventories		46,861.48
Furniture and Fixtures—Arbitrary Value		1,000.00
Prepaid Expenses		39,378.47
Total Assets		$1,160,350.13

LIABILITIES AND RESERVES

Accounts Payable		$ 22,349.55
Section Dues Payable		11,419.00
Deferred Credits to Income:		
Member Dues Received in Advance		144,293.42
Industrial Income for Technical Board Services		20,865.44
Subscriptions		17,900.02
Others		32,315.67
Reserves for Unexpended Memorial Funds		14,943.14
Reserve for Golden Anniversary Expenses		3,931.17
General Reserve		892,332.72
Total Liabilities and Reserves		$1,160,350.13
x Investments carried at cost—		
9/30/54 Market Quotation or Redemption Values—U. S. Gov't Bonds		$474,012.00
Market Quotation Values—		
Stocks	$297,279.08	
Cash	57.01	297,336.09
		$771,348.09

Accountants' Certificate

Society of Automotive Engineers, Inc.:

We have examined the balance sheet of the Society of Automotive Engineers, Inc. as of September 30, 1954 and the related statement of income and expenses, and general reserve for the year then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the accompanying balance sheet and statement of income and expenses, and general reserve present fairly the financial position of the Society at September 30, 1954 and the results of its operations for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

New York,
November 16, 1954.

Haskins & Sells

INCOME AND EXPENSE STATEMENT

October 1, 1953 to September 30, 1954

INCOME		
Membership		
Dues Earned	$ 320,354.41	
Subscriptions Earned	107,515.68	
Initiation Fees	39,763.00	
Miscellaneous Membership Income	1,530.38	$ 469,163.47
Publications		
Journal and Transactions Sales	58,843.92	
Journal Advertising—Less Agency Commissions	444,648.70	
Handbook Sales—1953	7,046.50	
Handbook Sales—1954	23,088.50	
Handbook Advertising	19,117.50	
Aeronautical Publications Sales	40,386.27	
Special Publications Sales	56,231.26	
Miscellaneous Publications Income	5,382.35	654,745.00
National Meetings		
Guest Registrations and Papers Sold at Meetings	20,429.34	
9 Dinners	44,399.46	
3 Displays	40,385.00	
Summer Meeting	9,712.50	114,926.30
Securities		
Interest	13,531.45	
Dividends	8,431.90	21,963.35
Cash Discounts Earned		1,519.70
Industrial Income for Technical Board Services (including $15,665.90 transferred from Deferred Credits)		215,964.88
Total Income		$1,478,282.70
EXPENSES		
Sections and Membership		
Direct Expenses		
Sections	$ 13,879.89	
Sections Appropriations & Dues	70,037.00	
Membership and Students	45,122.92	
Miscellaneous Membership Expense	1,242.41	$ 130,282.22
Pro-Rated Administrative Expense (11.5%)		33,098.00
		163,380.22
Western Branch Office —		
Direct Expenses		23,902.55
Pro-Rated Administrative Expense (2.2%)		6,331.79
		30,234.34
Carried Forward		$ 193,614.56

Expenses—Brought Forward	$193,614.56	
Publications		
Direct Expenses		
Journal and Transactions Text	206,231.06	
Journal Advertising	205,834.69	
Handbook Mailing—1953	551.30	
Handbook Text—1954	84,726.10	
Handbook Advertising	8,552.71	
Aeronautical Publications	22,870.45	
Special Publications	39,634.04	
Roster	35,698.94	
Miscellaneous Publications	5,682.95	609,782.24
Pro-Rated Administrative Expense (53.9%)		155,128.22
		764,910.46
National Meetings		
Direct Expenses		
Department Expense	53,329.34	
Cost of Registrations and Papers	11,821.37	
12 Meetings	56,897.91	
9 Dinners	42,147.01	
3 Displays	14,552.82	
Awards	589.75	179,338.20
Pro-Rated Administrative Expense (15.8%)		45,473.78
		224,811.98
Technical Board Services		
Direct Expenses		
Technical Committee Operations	$ 148,558.53	
CRC Appropriation	30,000.00	
Solicitation Expense	9,630.11	188,188.64
Pro-Rated Administrative Expense (16.6%)		
Industry Share		27,776.24
		215,964.88
Members' Share		20,000.00
		235,964.88
Total Expenses Composed of:		
Direct Expenses	1,131,493.85	
Pro-Rated Administrative Expenses	287,808.03	1,419,301.88
Provision for Reserve for Doubtful Accounts		5,000.00
Total		1,424,301.88
Excess of Income over Expenses & Provision		53,980.82
General Reserve at Beginning of year		838,351.90
General Reserve at End of Year		$ 892,332.72

important member services for the purpose of setting aside more than a reasonable surplus in any one year.

Finance Committee Follows Operations Closely

The SAE Finance Committee budget for the new fiscal year was approved by Council at its October meeting. This budget provides for a black figure of $23,500 which appears adequate in view of the current standing of general reserves. However, it was recognized that the prior year's results had been better than budget predictions largely because of the high level of Journal advertising revenues which make up a substantial part of all income but are subject to quick fluctuations in one direction or another.

Reserves

General reserves stand at $890,000 and at September 30 included investments at cost in U. S. Government Bonds of $495,000 and equity securities of $210,000.

Vigilance

The Finance Committee follows operations on a monthly basis for the purpose of making such interim recommendations to Council as seem desirable in the course of the budget year.

Services to Industry

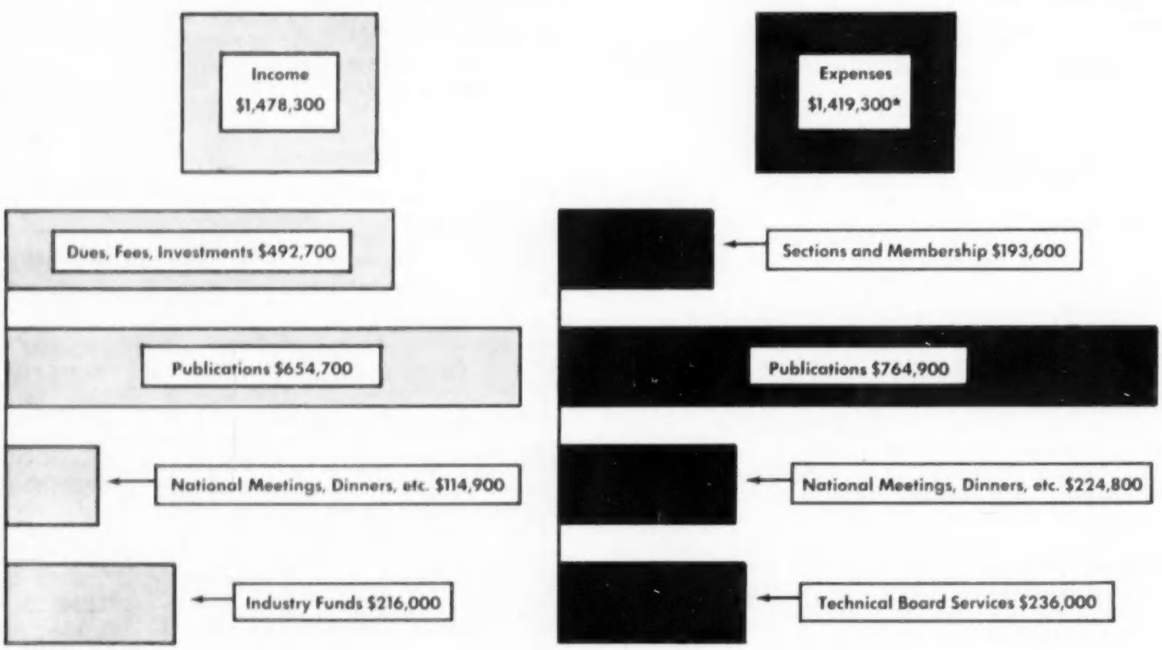
Funds from industry to support the technical committee work are running at the rate of $200,000 per year but heavy demand for the work is creating expenses necessitating expenditures which at present are running slightly higher than receipts.

Therefore, receipts had to be supplemented the past fiscal year by withdrawals from the Deferred Credit Account originally set up for this purpose. It is hoped that this gap will be closed through the development of additional sources of revenue.

The Future

Increasing membership is bringing with it additional costs. Such items range from larger mailing lists to the printing of more Rosters. However, the membership trend is constructive and the Society's financial position appears sufficiently strong to meet any foreseeable economic reversal.

Where SAE Funds Came from . . . and How They Were Spent



*Includes administrative expenses of $287,800 prorated among the four expense classifications.

C. G. A. Rosen—1955 SAE President

CARL George Arthur Rosen was the eldest of a family of six, born in 1891 of Swedish immigrants who settled in San Francisco before the turn of the century. His mechanical curiosity began to develop when his Dad put him to useful work after school hours in his carriage shop. It was there he witnessed the repair of the rear axle of the first automobile in his town. From the Embarcadero in San Francisco he watched the long line of sailing ships give way to the diesel ocean liners. As a freshman at the University of California, he saw one of Bleriot's first monoplanes hedgehop over a farm.

For a year after receiving his B.S. from the University of California in 1914 he busied himself by making miniature power plant models for several companies for showing at the Panama Pacific Exposition in 1915.

Soon thereafter he went to work as a draftsman for Dow Pump and Diesel Engine Co., where he rose to the position of Chief Engineer before leaving in 1922. At Dow he was responsible for the design and installation of two four-cycle, direct reversible Diesel engines for the new vessel "The Libby Main" which pioneered many unique features as a forerunner of later American diesel ship propulsion practice.

He served various governmental agencies during World War I and acted as Chief Engineer of Pacific Diesel Engine Co. in 1923. He engaged in practice as a consulting and research engineer in San Francisco in fields of design, construction and maintenance of large diesel engines. At the same time, he conducted courses in diesel engines for the University of California Extension School.

In 1928 Caterpillar Tractor Co. asked him to take charge of a program to develop a diesel engine for tractor application. By 1931, the fruits of this effort produced the first Caterpillar diesel. With establishment of research activities at its Peoria plant, Rosen moved to Peoria in 1938. There he continued in charge of diesel development. In 1942 he was made Director of the newly established Research Department, and is now Consulting Engineer to the President of Caterpillar.

Rosen's activities have received wide acclaim throughout the world of engineering science and in the interest of his company's product. At the invitation of governmental and scientific organizations, he has travelled throughout this continent, Hawaii, England and Western Europe meeting with scientific bodies and lecturing widely on engineering subjects.

Rosen's interest in encouraging and promoting interchange of technical knowledge has led him to many high responsibilities with national engineering societies in the automotive, mechanical and petroleum branches. He is a past vice president of SAE and was instrumental in founding the SAE Construction and Industrial Machinery Technical Committee (CIMTC). During World War II he was chairman of the SAE Torsional Vibration Committee, solving problems associated with submarine and surface craft. During the last months of the war he was a member of the Navy technical mission designated to uncover the German developments in sustained under-water submarine operations. He also served as chairman of the SAE Army Ordnance Advisory Committee and has been a member of numerous other SAE committees.

Mr. Rosen is a Lecturer on the faculty of Stanford University, a Fellow life member of ASME, a member of the British IME and has been their James Clayton Lecturer. He presented the 1952 ASM Woodside Lecture, has been active in ASTM and CRC endeavors. He is currently a member of the Vehicles Panel, R & D Board, USOD. He is a member of Sigma Xi and Pi Tau Sigma.

Both Mr. and Mrs. Rosen love the outdoors and are expert horse people and dog fanciers. They maintain stables in Peoria as well as on their ten acre "Tjockebo Ranch" situated in the shadow of the redwood forests close to Woodside, California.

Art Rosen is just as comfortable before a group of graduate students at Stanford, lecturing on the principles of diesel combustion or gas turbines, as he is speaking to a church group or on the lecture platform emulating the principles of the will to serve, the will to discipline oneself and the need to develop more creative thinking.

COUNCIL

William Littlewood

Completing the 1954-55 term as Councilors are W. C. Heath, Solar Aircraft Co.; J. G. Holmstrom, Kenworth Motor Truck Corp.; and F. Glen Shoemaker, retired. B. B. Bachman, Autocar Div., White Motor Co., serves again as Treasurer. Robert Cass, White Motor Co., and William Littlewood, American Airlines, Inc. continue on the Council as past-presidents. All vice-presidents representing Activities are members of the Council. Shown below are the three new Councilors for 1955-1956: M. C. Horine, Mack Manufacturing Corp.; M. P. Jolley, Canadian Acme Screw & Gear, Ltd.; and W. G. Nostrand, Winslow Engineering Co.

F. Glen Shoemaker

Robert Cass

B. B. Bachman

W. C. Heath

John G. Holmstrom

William G. Nostrand (M '43) is vice-president in charge of sales and engineering of the Winslow Engineering Co. in Oakland, Calif. and Winslow Engineering, Inc. of Murray, Ky. Nostrand has been with this pioneer filter company for 14 years.

A graduate of the University of California, Nostrand joined Winslow after serving in the Engineering Department of Fairbanks, Morse & Co. He started as an engineer with Winslow and was subsequently named chief engineer, executive engineer, and vice-president.

One of the pioneers in the application of full-flow filtration, Nostrand has presented several SAE papers on the subject and is currently on the Government's Standardization Committee for full-flow filters.

He has served as Northern California Section Chairman and was general chairman of the National West Coast Meeting in August, 1952. In addition to his SAE activities, Nostrand is an active participant in other engineering groups.

W. G. Nostrand

M. C. Horine

Merrill C. Horine (M '17), consulting engineer of the Mack Mfg. Corp., has been a member of the Mack organization since 1918. His connection with the automotive industry dates back to 1907, with A. C. Stewart of Los Angeles, a builder of marine gasoline engines and agent for the Dorris car.

As a member of SAE, Horine served as Vice-President, representing Motor-Truck and Motorcoach Engineering in 1933, now the SAE Truck and Bus Activity. He also served as Chairman of the Metropolitan Section 1938-39. For a number of years he was chairman of the Motorcoach and Motor-Truck Division of the Standards Committee and has been Chairman and member of numerous regular and special committees. In 1953 he received a Certificate of Appreciation from the SAE Technical Board for his work on the Truck and Bus Technical Committee and the Commercial Motor-Vehicle Nomenclature Committee.

Besides his SAE affiliation, Horine is a member of the American Ordnance Association, American Automobile Association, American Legion, Forty-and-Eight and the Masons.

Col. M. P. Jolley O. B. E. (M '45), is vice-president and general manager of Canadian Acme Screw & Gear, Ltd., Toronto, Ont., Can. and its subsidiaries; York Gears Ltd., Galt Machine Screw Co., Ltd., and Monroe Acme, Ltd. He is also director of Russell Industries, Ltd.; John Bertram & Sons Co., Ltd.; Canada Cycle and Motor Co., Ltd.; Ontario Research Foundation; and Canadian Arsenals, Ltd.

Jolley, born in Foster, Que., graduated from McGill University in 1933 with a Mechanical Engineering degree.

In 1940 he organized Small Arms, Ltd., and became its president in 1942. Later he organized Canadian Arsenals, Ltd., as its president.

Jolley participated actively as general chairman of the SAE Production Forum at the 1953 International Production Meeting in Toronto, was Chairman of the SAE Canadian Section during 1950-51, and is a member of the Production Activity Committee.

Jolley is also an active member of McGill Graduates Society, Mississaugua Golf and Country Club, Ltd., University Club and Granite Club.

M. P. Jolley

COUNCIL

R. Dixon Speas

Vice-President, Air Transport

R. Dixon Speas (M '41), aviation consultant at LaGuardia Field, L. I., N. Y., graduated from Massachusetts Institute of Technology in 1940. Previous to receiving his B.S. degree from M.I.T., he completed the Transport Pilot Course at Boeing School of Aeronautics, where he received a transport pilot rating.

Speas worked directly for Trans World Airline and American Airlines, Inc., before undertaking his consultant work. He resigned from American Airlines in May, 1950, to accept the position of U. S. Representative—AVRO Canada, on their jet transport plane, the "Jetliner." When work on the Jetliner was postponed in early 1951, Speas resigned and established business as an aviation consultant at LaGuardia Field.

He is the author of "Airplane Performance and Operation," a manual for aircraft flight crews, which appeared in 1943. He also wrote "Airline Operation."

Active in professional societies, Speas has been Chairman of the SAE Metropolitan Section and also of the New York City Section of the Institute of Aeronautical Sciences. He is an Associate Fellow of the Royal Aeronautical Society and is a member of the Council of the Wings Club of New York.

James D. Redding

Vice-President, Aircraft

James D. Redding (M '41), who joined the Aviation Gas Turbine Division of Westinghouse Electric Corp. October 1 as staff assistant to the chief engineer, received his A.B. degree from Wittenberg College and his B.S. in Aeronautical Engineering from the University of Michigan in 1930. After spending the summer as a structural engineer with Goodyear Zeppelin Corp., he returned to Michigan and obtained the degree of M.S. in Aeronautical Engineering.

His next five years were devoted to structural design, test and liaison engineering with Stinson Aircraft Corp., Consolidated Aircraft Corp., and Curtiss Airplane & Motor Co. From 1936 to 1941, Redding served as an aeronautical engineer with the Bureau of Air Commerce and its successor agency the C.A.A.

In 1941 he joined the SAE staff as Manager of the Aeronautical Department and spent the next eight years organizing and coordinating the SAE aeronautical standards program. From 1949 to 1954 he served in the Department of Defense as Executive Director of the R.D.B. Committee on Aeronautics and later as Technical Assistant to the Deputy Assistant Secretary of Defense for Research and Development. He has been active in the Washington Section, serving as Chairman in 1953-54.

F. E. Carroll, Jr.

Vice-President, Aircraft Powerplant

F. E. Carroll, Jr. (M '47), chief engineer of United Aircraft Products, Inc., received his formal education at Carnegie Institute of Technology. This was followed by six years of work with Westinghouse Air Brake Co., two years in the shop and four in the Engineering Department, Testing and Quality Control Section.

In 1942 Carroll joined the Air Force and was an instructor in Armament School. He was then transferred to Wright Field Power Plant Laboratory and assigned as project engineer on Aircraft Oil Systems in 1943. Additional duties included participation in Power Plant Laboratory test flights in various aircraft.

Following the war and separation from the Air Force, he continued work in the Power Plant Laboratory as assistant chief and then chief of the Engine Cooling and Lubrication Systems Unit where he was concerned with power plant installation problems.

Carroll joined United Aircraft Products, Inc. in early 1951 as assistant chief engineer and became chief engineer in the latter part of the same year.

He has presented several papers before meetings and has been active on the Aircraft Powerplant Activity Committee during the past years. Carroll is a member of ASME and IAS.

COUNCIL

H. S. Kaiser

Vice-President, Body

H. S. Kaiser (M '26) has the position of chief body draftsman in charge of design and personnel with Pontiac Motor Division, General Motors Corp. He has been serving in various divisions of GMC since 1928, when he left Chrysler Corp.

From 1940 to 1943 he served as senior designer on Army and Naval Ordnance with Pontiac, contributing to the design of an experimental airborne jeep, miscellaneous gun carrier and torpedo developments, and an anti-aircraft gun sight. He received a merit of award from the Navy Department for technical contribution to anti-aircraft trajectory development.

Kaiser attended the Stivers Technical School in Dayton, Ohio, studied mechanical engineering in the American School, Chicago, took refrigeration and air conditioning at the Utilities Institute, Chicago, studied business administration in the Detroit School of Commerce, and did extension work at the University of Detroit and the University of Michigan.

Other than his activity in SAE, Kaiser is a member of the Engineering Society of Detroit and is a Charter Member of the American Society of Body Engineers.

Fred A. Robbins

Vice-President, Diesel Engine

Fred A. Robbins (M '46) is chief engineer of the Piston Ring Department of Koppers Co., Inc., Baltimore, Md. In this position, he is in charge of all engineering activities for American Hammered Industrial Piston Rings.

Formerly a consultant to the Coordinating Research Council in New York City, Robbins directed the analysis during 1953 for the full-scale Railroad Diesel Tests. He also served as senior project engineer in Diesel Engine Development for the Electro-Motive Division of General Motors Corp. in La Grange, Ill., from 1942 to 1952.

Active in technical society work, Robbins served as Vice-Chairman, Meetings, Diesel Engine Activity of SAE during 1952.

A native of Hornell, N. Y., Robbins graduated from Purdue University in 1939 with a Bachelor of Science degree in mechanical engineering. He is a member of Tau Beta Pi (Engineering) and Pi Tau Sigma (Mechanical Engineering) honorary fraternities.

W. Paul Eddy, Jr.

Vice-President, Engineering Materials

W. Paul Eddy, Jr. (M '37), chief of Engineering Operations, Pratt & Whitney Aircraft Division of United Aircraft Corp., has been with Pratt & Whitney 11 years. He joined as materials engineer; two years later he was made chief, Engineering Operations.

After serving in the Coast Artillery Corps, in World War I, Eddy attended Syracuse University and graduated as Chemical Engineer in 1923. He was engaged in chemical and metallurgical work successively with Crucible Steel Co. of America, Geometric Tool Co., and General Motors Corp. (Brown-Lipe-Chapin and Truck and Coach Divisions).

Eddy is the author of some two dozen technical papers, mostly on metallurgical subjects. In SAE he has been a member of the Technical Board, and Chairman of the Southern New England Section. Also, in January 1954, the SAE Technical Board awarded him a Certificate of Appreciation for his contributions as Chairman of the War Engineering Board Iron and Steel Committee and the SAE Iron and Steel Technical Committee.

COUNCIL

John F. Kunc, Jr.

Vice-President, Fuels and Lubricants

John F. Kunc, Jr. (M '38) is section head in charge of exploratory petroleum product quality and development research at the Research Division of Esso Laboratories, Standard Oil Development Co.

He has been with the Standard Oil Development Co. since 1926 and has been engaged in fuel and lubricant research since 1934. During World War II he conducted and in 1944 was put in charge of aviation fuel quality research for this organization. From 1947 to 1951 he was section head of automotive fuel and lubricant research and assumed his present position during the latter part of 1951.

Kunc is active in the Coordinating Research Council and is a member of the American Chemical Society, the Nuclear Engineering Division of the American Institute of Chemical Engineers, and the Atomic Industrial Forum.

He became a member of the SAE Fuels and Lubricants Activity Committee in 1951 and served as Meetings Vice-Chairman of this committee in 1954. He also has contributed a number of papers to SAE.

Kunc is a graduate of the Brooklyn Polytechnic Institute with a B.S. degree in chemistry.

Robert F. Kohr

Vice-President, Passenger Car

Robert F. Kohr (M '20) is Director, General Engineering, Engineering Staff, Ford Motor Co.

Graduating from the University of Michigan as B.S.M.E. in 1917, he was an officer in the Engineering Corps and Tank Corps during World War I. From 1920 to 1926 he served in engineering capacities in the Automotive Power Plant Section, Bureau of Standards, and the Engine Section, Bureau of Aeronautics, and was responsible for the development of ballast recovery equipment for lighter-than-aircraft.

From 1926 until his association with Ford, Kohr has served with Studebaker, Bendix, Asbestos Mfg. Co., Packard, and General Motors, which he joined as chief liaison engineer in the Aircraft Development Section when World War II shut off automobile production.

After V-E Day he joined the Ford Motor Co. as assistant director of research. In 1948 he was promoted to director of research and in 1951 became executive engineer, General Engineering. The change to his current title was made in 1954.

Kohr is a Past Chairman of the SAE Washington Section and a member of Tau Beta Pi.

Paul A. Miller

Vice-President, Production

Paul A. Miller (M '49) has recently become associated with Ford Motor Co.'s Parts and Equipment Division as manager of Manufacturing-Engineering.

Previous to this appointment, Miller had been with the Leece-Neville Co. in Cleveland for 20 years, after attending Cleveland College of Western Reserve University, taking specialized subjects to further his progression at Leece-Neville. He started as assistant foreman and worked his way up to his election as vice-president in 1951. During this time he also spent three years in the Ohio National Guards, 112th Engineers, and three years of Citizens Military Training at Ft. Benjamin, Harrison, Ind.

In SAE, he has been Vice-Chairman for SAE Cleveland Section's Production Activity Committee during the present year and has been Meetings Vice-Chairman for the Production Committee. He was General Chairman of the National Production Meeting held in Cleveland in 1953 and was a member of SAE Cleveland Section's Governing Board the same year.

Miller is also an Executive Board Member of the Cleveland Works Managers Group.

COUNCIL

Trevor Davidson

Vice-President, Tractor and Farm Machinery

Trevor Davidson (M '46) is chief engineer, Development and Research, Bucyrus-Erie Co.

He was born in Buffalo, N. Y., in March, 1900. In 1921 he received a B.S.M.E. from Massachusetts Institute of Technology. That same year he joined Bucyrus-Erie as a special apprentice. Two years later he became a member of the Engineering Department.

During World War II, Davidson worked on special developments in heavy field artillery gun carriages. He now has some 25 patents on shovels, draglines, bulldozers, scrapers, and gun carriages.

In SAE Davidson has served as a member of the Steering Committee of the Construction and Industrial Machinery Technical Committee from the time it was organized in 1947 until 1954, and also has served as chairman of several subcommittees.

His papers have been presented at the Tractor Meeting, the Earthmoving Industry Conference of the Central Illinois Section, and Milwaukee Section meetings.

Robert Gardner

Vice-President, Transportation and Maintenance

Robert Gardner (M '39), now a member of the Washington Section, is a native New Englander. He has served in various SAE capacities for the Metropolitan and New England Sections.

In 1954 he was General Chairman of the National Transportation and Maintenance meeting held in Boston; and was Meetings Vice-Chairman of the SAE Transportation and Maintenance Activity Committee during 1953. He served as Chairman of the New England Section in 1947-48.

At the present time, he is Staff Engineer of the Regular Common Carrier Conference of the American Trucking Associations, Inc., with headquarters at Washington, D. C. Previously, from 1937 to 1953, he managed the national fleet of Lever Brothers Co., New York City. During World War II, he served on active duty with the U. S. Coast Guard on shore and coastwise patrol with the First Coast Guard District.

Gardner attended Boston University. He is a member of Highway Safety Associates and of the National Advisory Committee for Fleet Supervisors Training Courses.

R. C. Norrie

Vice-President, Truck and Bus

R. C. Norrie (M '37) is chief engineer for Kenworth Motor Truck Corp. He received his B.S.M.E. from the University of Washington in 1932 and entered the automotive industry as a draftsman with Kenworth in 1934. He became assistant chief engineer in 1942 and assumed his present position in 1945.

Norrie designed many of the first aluminum alloy parts used by Kenworth in their vehicles since 1937 and has contributed to the design of the T-10 Gun Transporter, the BARC, all-wheel drive vehicles for the deserts of Saudi, Arabia, and the sugar cane fields of Hawaii, as well as off-highway logging trucks.

He has served in the SAE Northwest Section as Program Chairman, Vice-Chairman, and as Chairman during 1953-54. He is also a member of the Truck & Bus Technical Committee and has served on several technical subcommittees.

165

~~1827~~ Engine Parts

Industry-military program reduces parts by standardizing military engines

J. H. Horton, Engineer Research and Development Laboratories, Fort Belvoir, Virginia

Based on paper "Standardization of Military Industrial Engines," presented at SAE Tractor Meeting, Milwaukee, Sept. 14, 1954.

COOPERATION between the automobile industry and the military has made it possible to go a long way towards standardizing engines and accessories for military use. Where previously there were 1827 different major engine parts, there are now only 165—a 90% reduction in high mortality parts.

This saves incalculable dollars and man hours in all phases of procurement, production, tooling, cataloging, storing, issuing, training, operation and maintenance. And this program has set the stage for further standardization of accessories, larger bore engines, and diesels.

During World War II the need for standardizing military engines was forcibly illustrated. Over 339 different makes and models of industrial engines were used by the Armed Forces. The logistic and maintenance problems were tremendous. Often the spare parts on hand at a particular front would not fit a specific engine. Thus, a high percentage of the engines had to be deadlined when they broke down.

In 1948, the Munitions Board established an Industry Advisory Committee to solve the problem. The Committee consisted of top engineers and executives from all parts of the engine industry.

They decided that standardizing parts that could be interchanged in a number of different engines would be better than developing a standard military engine design or choosing one commercial make as the standard. This would take advantage of existing tools and production facilities. It also allows for technological improvements, enables full use of the industry facilities during mobilization, and encourages full industry participation in the program.

First, basic bore sizes were selected. Of the 44 different bores, these 12 were taken as standard: $2\frac{1}{4}$, $2\frac{1}{2}$, 3, $3\frac{1}{4}$, 3-7/16, $3\frac{3}{4}$, 4, $4\frac{1}{4}$, $4\frac{5}{8}$, 5, $5\frac{3}{8}$, and $5\frac{3}{4}$ inches.

Then, basic dimensions of the engine parts were agreed upon. Various manufacturers took on the job of modifying and testing their engines with the standardized parts. Engines selected for modification included air and liquid cooled types, L-head and valve-in-head types, engines of 2, 4, 6, and 8 cylinders and engines with 2, 3, 4, 5, and 7 main bearings. Displacement ranged from 44 to 1091 cu in.

Of 224 internal combustion engines, 74 were modified and adopted for the program. Other production model engines can likewise be modified to accommodate the standardized high mortality parts. What the committee has accomplished is shown in Fig. 1.

The number of pistons were reduced from 203 to 21, piston pins from 194 to 11, valves from 383 to 30, and so on, for a total reduction from 1827 to 165.

Also, piston rings were reduced to 39 (excluding oversizes) which will be stocked in only 14 different sizes. This is a small fraction of what would be required for the complete range of commercial engines.

Surprisingly, the modified engines in most cases performed equally as well and in some cases were

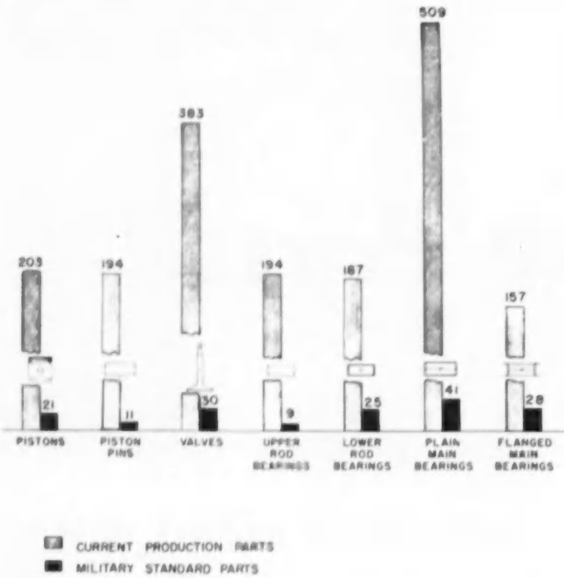


Fig. 1—This is a comparison of current production parts and military standard parts for 4-cycle, multi-cylinder, gasoline engines in the 2⅛ through 6 in. bore size. Total reduction of high mortality parts was 90%

actually superior to the corresponding commercial model. Fig. 2 shows a comparison of the specific power output of 35 of the modified engines with the production counterparts. 22 of the 35 produced equal or greater horsepower per cu in. displacement at 1800 rpm than the standard production model. And there was no attempt to improve performance by refinements in carburetion, manifolding or other adjustments.

A similar program for the 16 engine accessories listed (below) was started in October 1951. Overall

These accessories for industrial engines are being standardized to allow interchangeability.

Air Cleaners	Thermostats
Generators and Regulators	Radiator and Air Cleaner Hose
V-Belts	Flywheel Housings, Hand Cranks, Engine Mounting Dimensions
Governors	Lubricating Oil Filters
Carburetors, Fuel Pumps, and Fuel Filters	Distributors and Coils, Magnetos, Ignition Wires, and Spark Plugs
Tube Fittings and Drain Plugs	Starting Motors
Radiator Pressure Caps and Fuel Tank Caps	Storage Batteries
Temperature and Pressure Gauges, Tachometers, and Ammeters	Radiators

dimensions and mountings are being standardized to allow unit interchangeability. For example, 156 battery-charging generators now in military supply will be replaced by two 24 v. units. And most of the major parts in the generators are interchangeable. Work on air cleaners, oil filters, starting motors, and V-belts is progressing rapidly.

By the end of the year, revisions of military procurement specification lists will be completed. Then, approximately 75 different engine models, from $2\frac{1}{4}$ to $5\frac{3}{4}$ in. bore size, and from 10 to 150 net continuous horsepower, will be officially standard for military use.

Also, provision has been made for future changes. An Engine Standardization Review Committee has been set up to periodically review the standards.

Standardizing high mortality parts in diesel engines is inherently more difficult. One major reason is the variety of combustion chamber designs which require different piston head configuration. But standardization of valves, bearings and certain bore sizes appear to be possible.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

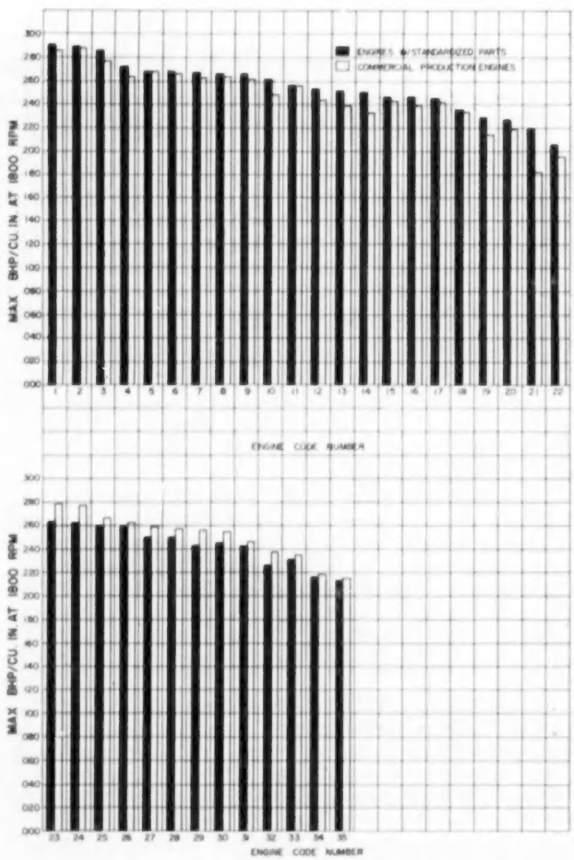


Fig. 2—22 of 35 engines with standardized parts produced equal or greater hp per cu in. displacement at 1800 rpm than the standard production model

Based on Discussion

B. G. Van Zee, Minneapolis Moline Co.

The use of standardized parts in our engines has worked out very well. Service life has been satisfactory. I believe that speaks well for the parts as we have speeded up all our engines to meet the 1800–2000 rpm requirement.

The engine test at – 80 deg cold soak presents very difficult problems. There are no set rules as to what to check or test. Also it is difficult to procure, ship, and store the specified test fuel and oil.

We have not been able to find a thermo couple that would stand up under continued testing of exhaust gas temperatures.

These manufacturers have modified engines to use Military Standard parts.

Aerojet-General Corp.	Hudson Motor Car Co.
Buda Co.	International Harvester Co.
J. I. Case Co.	LeRoi Co.
Chrysler Corp.	Minneapolis-Moline Co.
Continental Motors Corp.	D. W. Onan & Sons, Inc.
Ford Motor Co.	Twin Coach Co.
Hall Scott Motor Division, ACF-Brill Motors Co.	Waukesha Motor Co.
Hercules Motors Corp.	White Motor Co.
	Willys Motors, Inc.
	Wisconsin Motor Corp.

G. W. Thomas, Continental Motors Corp.

In the standardized engines, cylinder bore spacing, block height, and block length, usually remained the same as in the production models. These engines all retain their exterior appearances, yet each one is able to use interchangeable pistons, piston pins, pin bushings, piston rings connecting rod bearings, and main bearings.

Teamwork Is Vital . . .

. . . to couple high quality with low inspection costs. Quality control and manufacturing men need to see through each other's eyes.

Based on paper by **V. A. Nichols,** Bendix Products Division, Bendix Aviation Corp.

COOPERATIVE thought and action by related departments is the only road to high quality and low inspection costs. Minor, as well as major, quality-maintenance problems require inter-department teamwork. When the manufacturing department is quality-minded and the quality control department schedule-minded, costs come down and quality goes up.

Defects so strongly affect production schedules and overall product cost that management usually is willing to pay whatever is necessary for quality control. Experience has shown that when quality goes up, costs come down. Today most companies feel that a quality control and inspection cost ranging from 1 to 3% of the total sales dollar is not too much to allot. Figured as a percentage of total direct labor cost, 10% probably is a realistic figure for manufacturing and assembly inspection labor cost. Likewise, the total cost of the entire inspection and quality labor cost, including salaried personnel, should be maintained within 20% of the direct labor cost for effective economic operation.

Rising inspection costs, due to the highly developed articles now being manufactured, are additional reasons for close controls on inspection expense. Replacement of attribute type of gaging ("go" and "no go" gages, for example) with variable types, made on the basis of statistical quality control studies, will usually reduce labor costs enough to more than offset the increase in gaging costs.

It pays to have inspection men and production men trained to understand the same standards. And the quality control group does its best job when it is made a part of the specification-creation team. When designers, production men, and quality control men all work toward a common goal, realistic conclusions are reached. The purchasing department may well participate, too, especially in getting vendors together with its factory group—*before* the vendor goes into production.

In formulating proper design for jigs and fixtures, the actual experience of all departments is particularly needed. Poor planning of tooling programs too often introduces scrapping of unusable gages and fixtures. Deviations during initial tool setups bring nightmares. When the nightmares scare quality control into makeshift measures, lower quality and higher costs are sure to result.

Cooperation between related groups helps also to avoid the dangerous practice of adding tolerances on tolerances. It brings a needed harmony between

the quality of the design and the quality of the end product conformance. Many times, due to the economies of a case, it is better to continue deviation than try to disturb the process which is causing it.

To a certain extent, any machine or process is its own inspector. "At the time of operation," one production engineer points out, "this inanimate gadget is the only source which holds the secret of produced quality. So, the problem simply is to assure that this producing gadget be made to repeat itself within the certified limits."

Manufacturing department consciousness of quality needs is required particularly when floor inspection is the responsibility of manufacturing. There is always danger that schedule-meetings will be emphasized too strongly to the floor inspectors. Experience shows that too much de-emphasis on quality in such cases can pile up defectiveness—and increase screening costs. Manufacturing doesn't always understand that lengthened inspection intervals probably mean more and closer inspections when they are made. But with the growing understanding of the objectivity of quality control processes by manufacturing departments, placing responsibility for floor inspection with the manufacturing department is bringing many good results. Many hidden costs are reduced, experience indicates, and rework costs tend to go down.

Responsibility for building a quality product must rest with the manufacturing department fundamentally. The verification of the quality going to the customer rests with the quality division. Team effort between the two is necessary to effect the needed results.

(The Secretary's report of which this article is a brief abridgment is available, along with the reports of six other panels at this 1954 SAE Aeronautic Production Forum (NY) as SP-307, from the SAE Special Publications Department. Price: \$1.50 to members, \$3.50 to nonmembers. Chairman of this Panel was A. L. Johnson, Bendix Aviation Corp. Other members in addition to the Secretary were: V. A. Nichols, secretary, Bendix Aviation Corp.; Robert Smart, Wright Aeronautical Division, Curtiss-Wright Corp.; F. W. Rhode, Westinghouse Electric Corp.; C. G. Poehlmann, Thompson Products, Inc.; and G. Hardman, Republic Aviation Corp.)

Propane Motor Fuel With 15% Propylene . . .

. . . gives satisfactory performance with no engine knock, no harm to the engine, and very little deposit buildup.

Based on paper by **J. E. Ebinger,** Wichita Transportation Co., and

F. E. Selim and **R. W. Unterreiner,** Phillips Petroleum Co.

PROPANE fuel tests in buses of the Wichita Transportation Co. have shown that LPG motor fuel containing as much as 15% propylene is as satisfactory as natural gas grade LP-gas.

This is an important discovery because marketed propane often contains varying amounts of propylene and normal butane. (Current refining operations make it cheaper for refiners in some areas to include these two light hydrocarbons in commercial propane motor fuel.) Truck and bus engines designed to take advantage of the good anti-knock quality of propane may get detonation if the normal butane or propylene content becomes too great.

In 1952 a joint test program between the Wichita Transportation Co., and the Phillips Petroleum Co., was begun to determine the highest propylene and normal butane content that can be tolerated without knock at the standard spark setting of 10 deg BTDC. A 40 passenger bus with a Fageol FTC 180 engine was used. Investigation found that an LP-gas blend of 75% propane, 15% propylene and 10% normal butane gave knock-free operation. (The admixture of normal butane was to counteract an increase in vapor pressure resulting from the presence of propylene.)

Once the limitations from an antiknock standpoint were known, the effect of this fuel blend on octane requirement increase, preignition, combustion chamber deposits, and over-all engine performance was determined.

Tests in six city buses (three were used as test controls) over a six months period, in which each bus operated about 25,000 miles, discovered the following:

1. There was no discernible difference in fuel and oil mileage between buses using propane with 15% propylene and buses using fuel with no propylene.
2. Basic spark settings for trace knock were approximately the same, indicating that 15% concentration propylene will not cause knock.
3. Flaky deposits in the combustion chambers of the propylene test buses appear qualitatively and quantitatively similar to deposits found in the control buses. Cleanliness rating of over-all piston conditions were the same. In fact, no evidence of undesirable fuel effects were found on the cylinder head, intake and exhaust passages, spark plugs, valve parts or rocker assembly.
4. The carburetion system operated perfectly.
5. The propylene content had no unusual or detrimental effect on crankcase lubricant.
6. A special test using 30% propylene did not have

an adverse effect on L-4 copper lead bearing corrosion.

In summary, no evidence of unsatisfactory performance, excessive deposit build up, or engine wear could be found when using propane motor fuel with 15% propylene. (Paper "The Evaluation Of The Effect Of Propylene In Propane Used As a Motor Fuel," was presented at the SAE National Fuels and Lubricants Meeting, Tulsa, November 5, 1954. It is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Marine Engines . . .

. . . follow distinct design. But, as with motor vehicle engines, horsepower goes up to satisfy the craving for ever greater speeds.

Based on paper by **Paul A. Engstrom**, Gray Marine Motor Co.

THE majority of gasoline marine engines now built are adapted for marine use from a highly developed block assembly used for other power applications ranging from trucks to stationary powerplants. No leading manufacturer builds an engine from the "bilge" up.

Typical of practically all present day inboard engines is the positioning of the flywheel at the front (instead of at the rear of the engine as with other power applications) and the transmission at the rear, or opposite end.

Marine engines must taper to the rear to conform readily to the shape of the boat hull, hence the front end flywheel. Since the basic blocks are usually arranged to crank right hand, as in a vehicle, the entire assembly must be turned around to produce an engine that will turn a right hand propeller. This is more traditional than technical and we comply to keep peace in the family.

The typical transmission is either spur gear or bevel gear planetary. All that is needed is a forward, a neutral, and a reverse—operated preferably by a single lever while under torque and transmitting power in a straight line. The old fashioned planetary meets these requirements admirably. It is also compact, easily serviced and adjusted, with high torque capacity. It can be integrated readily into the engine lubricating and cooling system without undue complications. Compact, rugged, internal-type reduction gears, with minimum shaft offset, can be adapted to this type transmission.

Another feature of any marine engine is the completely water-jacketed intake and exhaust manifold. The main reason for this is safety. But it also complicates a marine designer's life, since it is the usual practice to combine the intake, exhaust, and water-jacketing into one casting. An important recent trend is toward some form of water heating of the intake manifold to improve low speed performance and acceleration, especially with high output models.

Most cooling systems make use of a positive displacement pump. The flows can be rather low as compared to the flows in a radiator system since the inlet temperatures will always be considerably lower than the usual closed system. A good rule-of-thumb for establishing pump capacity is about one gallon for every 10 hp. There are two things a marine engine pump must do well and without fail. It must prime at every start even if there is a 2 or 3 ft lift, and it must be capable of delivering the required amount of water against a back pressure of perhaps 25 psi.

The extensive use of oil coolers and jacketed transmission is due, of course, to the lack of road blast or radiation cooling.

Since most boats are built with heavy parallel stringers for engine support and hull rigidity, the engines must be 4-point mounted for easy installation. A variety of centers and angle or horizontal mounts in either solid or rubber are available.

Cast housings and brass fittings are used extensively. The reasons for this are: corrosion resistance, low initial cost for patterns as opposed to dies, and relatively low production volume of engines.

Everybody wants to go faster and faster, so naturally we are going to cooperate with this demand if it kills us. Currently I am deeply involved in the development of two series of engines aimed at satisfying this demand. The design features of one of these may be of interest.

- Horsepower—well over 200
- Rated rpm—3400 to 3600
- Displacement—427 cu in.
- Compression ratio—7.2:1
- Cam timing—20-22-57-63
- Valve lift—0.460
- Water heated dual intake manifold
- Weight per hp—6 lb

A pair of these in a 30 to 32-ft boat will produce speeds of from 38 to 40 mph. Installed in a 27 ft boat with full equipment, they have turned up to 45 mph.

Gasoline economy is not regarded as very important. While the specific fuel consumption of marine engines is comparable to other engines, it is a generally accepted fact that prolonged operation at high power output will eventually consume a gallon or two of gasoline. The same remark applies to oil consumption. (Paper "Marine Engines" was presented at SAE Western Michigan Section, Muskegon, April 20, 1954. It is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers).

Making

MANAGEMENT's decision to bring out new models depends primarily on the indicated cost as shown in pre-production estimates. There are two basic types of such estimates:

PRELIMINARY—before final engineering data is developed and only the most general outlines are available to guide the estimating group.

FORMAL—when final engineering data is available to provide the specific basis for the estimate.

1. Last Model Starting Point for New Model Costs

Preliminary estimates must be developed from observation of a tentative model or mock-up. A baseline is established by comparison with data on the last available comparable model and plus or minus factors are estimated with reference to this baseline. Only major components are considered and the estimate records the degree of departure from the baseline. The guess so obtained is management's initial guide to the approximate cost of new model projections. And it is the starting point for developing the pre-production estimate.

Between preliminary and formal estimates there is an accumulation of data from the earliest and most general concepts to the point where all data can be incorporated in drawings and the process of refinement is reached. Then, from major components the estimate is enlarged to include specific details and, as the project takes on status, informal conferences of interested departments become more frequent and formal.

In the earliest stages, there is no allowance made for possible adoption of new manufacturing tecniques. This is deferred for evaluation when preparing the formal estimate. When department liaison develops divergent views, they are resolved at weekly or monthly high level meetings. Thus, the estimate moves through the transition period and, as each component of the new design is released, the liaison meetings become more regular and formal until fully detailed estimates are developed.

The estimating group customarily releases its data to the cost accounting department as the project passes the preliminary stage. When final engineering on parts is released and the standards group has completed time estimates, the formal standard cost is developed by cost accounting rather than by the estimating group. With all data in the hands of accounting, the estimate is near presentation to management for appropriations.

To establish a new benchmark beyond the baseline of the preliminary estimate, the final estimate is prepared from drawings. By using a series of benchmarks, the basic design assumption is preserved and succeeding assumptions affecting the estimate are recorded. Engineering usually presents a benchmark listing in a form amounting to a rough bill of material, thoroughly annotated and making maximum use of known data on previous models.

Management's plan for releasing the product determines the time when the design is frozen and first released for production. If the design represents a major change, 18 to 20 months may elapse between preliminary estimating and release.

Pre-Production Estimates of New-Model Costs

J. J. Murphy, Hudson Motor Car Co.

Based on secretary's report of Panel on Production Tooling and Shop Methods—Pre-production and Cost Estimating on New Models held as part of the SAE Chicago Production Forum, March 29, 1954.

2. Cost Estimate Has to Reflect Design Changes

Usually a closing date on change is established. From then on changes are incorporated as "second production" or "peg point" changes and are not treated as new model changes. Changes are commonly accepted up to 60 days prior to introduction. After that date they are charged against "variance" accounts, reflecting their plus or minus on the standard cost previously established.

It is best in most instances to defer the freeze on changes until the engineering group believes the development sufficiently complete to go along with the presentation to management on product and price. Management decides the effectiveness of second production changes, the cost of which is not made part of the first production benchmark.

First production frequently creates the need for spot engineering changes. This may go on throughout the model year as improvements or discrepancies are indicated, and they may be covered as peg point or second production items. "Post-freeze" change is usually needed too quickly to permit adequate tooling and the cost of temporary methods used to effect changes is normally carried outside the standard cost on the model. Change is naturally abhored by the production group. Nevertheless, changes should be accepted promptly if they can be shown to be for the good of the product.

3. Estimates Furnish Budget Controls

Responsibility for reflecting the results of preliminary and formal estimating versus actual cost falls upon each department affected. Usually the production engineering activity, through a records group, maintains a follow-up on each tool and assigns the estimated tool design time and build cost. As each order is closed out, the actual cost is recorded against the estimate.

In some cases the production group prepares a monthly expense forecast with a 12 months projection. When reviewed and adjusted each month, it reflects the actual versus estimated cost in the last month's expenditures. With this continuous recording of expenditure against budget it is possible to see how the actual relates to the estimate.

In another instance, the estimate is divided into cost groupings for plant arrangement, tooling, machinery, and the like. Appropriations are budgeted in the groups. Then, if actual costs exceed estimates in one group and are lower in another, transfer of appropriations within groups is permitted.

The management of one company gets a quarterly report on major anticipated expenditures. This is prepared on a two-year projection and provides the best forward-thinking of the manufacturing departments.

It is customary to maintain an appropriation report on new models. This presents the over-all budget by groups and compares the budget monthly with appropriations and expenditures. As the pro-

On the panel which developed the information in the accompanying article were:

J. F. Jones, Panel Leader
Hudson Motors Division, American Motors Corp.

J. J. Murphy, Panel secretary
Hudson Motors Division, American Motors Corp.

E. W. Bernitt
American Motors Corp.

M. F. Macauley
Packard Motor Car Co.

L. K. Rosenberg
Detroit Diesel Engine Div., General Motors Corp.

Harvey Smith
A. V. Roe Co., Ltd.

T. G. Vickers
Clark Equipment Co.

gram is completed, usually when the product has been in production for some three months, the final figures are submitted in this report, making possible quick analysis of actual versus estimated costs.

Another concern uses a report in which actual monthly expenses are compared against estimates for each model in production. This provides a self-closing device.

Experience shows that estimates for new models vary in results in proportion to the quality and detail of the data available. Discrepancies arise from overlooking items or from misunderstandings rather than from lack of skill in estimating. The range of accuracy on the average is held to 3 to 5% on major programs or over long periods of time. On certain smaller components the variation may range from 300 to 400%, but such items tend to balance out and preserve the integrity of the estimate. The objective of estimating should be to break items down into the greatest possible detail, thus reducing the opportunity for misunderstanding.

If the estimate misses the actual cost by an appreciable margin, the standard cost must reflect it. When a true change occurs in the standard cost base of the product, then the standard should be revised to reflect the increase in permanent cost.

Practice varies, however. In one case the standard cost is fixed 60 days prior to first production and remains at that level for the model year. All succeeding changes are handled as variance items. Others change standards progressively with engineering changes, but costs due to temporary tooling are charged to variance rather than incorporated in the standard cost.

The product cost as it reaches production is reflected in operating sheets which provide the official basis for reflecting standard cost. In this connection it should be noted that some union bargaining agreements provide that estimated standard hours (derived from standard cost projection) constitute the official standard on specific operations until formal time studies are made. If no change from the estimated standard occurs within six months, that standard becomes final for the individual operation.

When management wants a reasonably close "spot" indication of cost to show the direction of a certain proposal, standards and estimating groups may obtain the basic cost elements and prepare a "quickie" estimate. Some organizations use a committee comprising representatives of mechanical, estimating, and cost control groups, for this purpose, or they get an analysis from the cost accounting department.

In one company, a small staff comprised of people with shop and cost backgrounds make spot estimates and report to the operations vice-president. The staff gets its data from cost history and its estimates are not binding on the manufacturing group as pre-production estimates would be. Normally, it works with engineering and production to adjust the running data for radical changes and to maintain a general indication of cost trends.

4. Tool Expense Control Depends on Timely Data

Various methods are used to measure and control tool expense. Management may issue authorizations for specific purposes, or the tooling for new projects may be controlled from monthly and annual budgets, including one for tool maintenance. All controls depend ultimately on the timeliness of accounting data.

In most accounting methods there is an inherent delay in reflecting actual costs as a project moves through its development. The lag can be as great as six weeks. For this reason various devices are employed to provide advance information.

In one instance, a records group maintains a history of each tool specified in the appropriation and records progressive expenses against it. Every effort is made to correlate these costs on a daily basis among all departments and the accounting group brings the data up to date on a weekly basis. In another instance, a report of the total "make" and "buy" position is available on the 10th of the month following the month of expenditure. This reflects the cost position on each tool relative to the total budget.

The "commitment" normally includes the release of a work order to the factory and assumes that all dollars authorized will be charged to that order for purpose of cost control. A running total of commitments is maintained and, in most instances, is

reported to management weekly. Individual commitments values are obtained from a secondary estimate based on individual tools.

Tool try-out and installation costs in machining and assembly operations may represent as much as 20% of the new model tooling cost. If the product cost is not changed appreciably by change in method, it is normally charged against an installation and try-out account. If the product cost is substantially affected, a formal change is made in the product estimate and special authorization is provided.

Methods for the physical checking out of tools vary with the part involved. Normally, the inspection department approves the first production pieces, and, in the case of machined parts, it is usually considered sufficient if the parts check out against the print. If enough parts are available, a trial assembly method may be followed. It is not general practice to run a pilot operation before assembling a complete product; parts are checked against gages and blueprints in normal quality control and inspection procedure.

Various methods are used to control tool procurement costs so that they fall within the pre-production estimate. In one instance, the production engineering group approves bid proposals exceeding a certain dollar figure. This gives only nominal control over the procurement group. The tooling estimate ordinarily is given to the purchasing group and all quotations are checked back through the material group against the estimate. This provides a definite control over procurement costs. When the procurement group cannot get quotations within the range of the original estimate, an investigation is made to determine if tools can be made in the company plant. If they cannot, an effort is made to redesign for cost reduction and submission of additional bids is requested. One concern permits an excess of 10% above estimate, but if the quotation exceeds this, a re-examination is required by affected departments.

Separate tooling accounts are kept on vendor special tooling, hence separate appropriations are established. Major components of vendor tooling are usually reviewed by the estimating group only for cost and design. In all other cases, tooling design is assumed to be adaptable if used in the company plant instead of by a vendor.

The principal objective of progressive reports which show the status of major components is to get the job into production and to provide for priority in the ordering of tool requirements. Such reports provide a technique for cost control without impairing their primary purpose of assuring delivery.

5. Tool Performance Research Key to Production Economics

There are three main types of tool research programs in use by the automotive industry. Their purpose is to:

1—Make an advance determination of the most efficient form of operation by pre-production test.

2—Make a determination of the most efficient cutting tools.

3—Indicate techniques to provide for changing of dull tools in advance of failure.

In several companies, the responsibility for obtaining approval of each tool installation is placed on the master mechanic's installation group. In one company a tool specialists group qualifies each installation. But in general, the industry has no broad program for maintaining a group devoted to tool research in the purely scientific sense. This is left to the cutting tool manufacturers and their material suppliers.

There is general agreement that a separate, formal research activity would be desirable, but that proposals to effect it should be controlled by economics—that a program should pay its own way. Tooling groups are limited in their effectiveness in tool research because of preoccupation with models going into production. All they can do is a trouble-shooting job.

A partial answer may be to run trials on maximum feeds and speeds and the capacity of cutting tools together with existing practices of tool try-out. This is desirable provided the investigations are carried on under the guidance of production engineering and provided the benefits are studied.

A distinction should be made between producers changing models regularly and those who change at long intervals and therefore maintain tooling and equipment over a long period. The latter should make a point of bringing their perishable tool applications up to date so as to take advantage of all advances made between design changes.

Detailed data on tool reconditioning should be recorded. This brings to the fore the data which is being generated daily in the shop but is not now being used to contribute to over-all tool performance.

Carbide tools have been found to vary greatly in performance even when identical tools are used under the same conditions. If there were opportunity and time to make a thorough analysis, the reason for variation might be determined. In lieu of this, the tendency is to specify the brands which have given the most dependable service.

Carbide application is limited by machine tool design, and the prospects for improved design are far from rosy. There is some question whether the industry is passing its recommendations along to machine tool builders, due to preoccupation with other cost cutting programs. As automation is advanced, heavier pressure will be put on machine tool builders to develop designs with greater capacity to handle carbide applications and do a machining job on the newer alloys.

(The full text of this report, together with the reports of other panels at this Production Forum, is available from SAE Special Publications Department, as SP-306. Price: $1.50 to members, $3.00 to nonmembers.)

Fig. 1—This is the S-59 helicopter that set a new World's Speed record of 156.005 mph., at Windsor Locks, Connecticut, on August 26, 1954. It was powered by the XT-51 fixed shaft gas turbine.

Fixed

THE helicopter industry has found it tough getting off the ground. For years engines available didn't quite satisfy the power and stamina needs of a vertical lift machine. Recent flight tests of the Continental XT-51 fixed shaft gas turbine have shown that this type of powerplant has certain advantages over the conventional piston engine for helicopter use.

The XT-51 is designed to give a helicopter adequate power and a simple constant speed control. It is compact and has less parts and accessories than a piston engine, reducing weight and sources of failure. It makes less noise and vibration. At the same time it is easy to install and repair. With all these advantages there is still room for improvement in fuel consumption and hot weather operation. Let's take a closer look at some of these features in a Sikorsky S-59 installation (See Figs. 1 & 2.)

Turbine Performance—The XT-51 gas turbine is better suited to helicopter use than a piston engine. Fig. 3 shows a comparison of similar sized helicopters using a 400-hp piston engine, a 320-hp piston engine, and the XT-51 400-hp turbine. The turbine installation including fuel and oil weighs only 29% of the gross aircraft weight. At equal gross weight (including fuel and oil necessary for flying the same distance) the 400-hp piston engine weighs 39%. The 320-hp piston engine weighs 31%.

The payload for the 400-hp turbine is 220 lb, while the payload for the 400-hp piston engine is only 130 lb. The 320-hp piston engine has a larger payload (360 lb). However at this gross weight its performance is at the minimum. Also, the turbine has an 80 hp advantage that can be used to increase performance and payload.

Fig. 4 shows a comparison of the same three en-

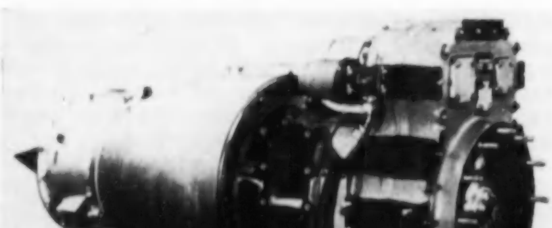


Fig. 2. The XT-51 fixed shaft turbine has the following specifications: power rating, 400 shp; dry weight, 230 lb; length, 41.3 in.; specific fuel consumption, 1.02 lb per shp per hr; height, 23.2 in; airflow, 7.0 lb per sec

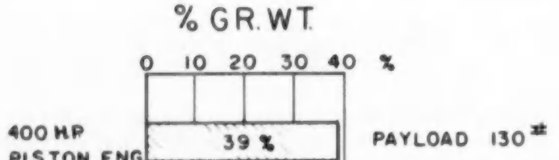


Fig. 3. Weight comparisons of three type engines. The turbine power plant installations, including fuel and oil, weighs 29% of the gross aircraft weight. The three aircraft had equal gross weights and enough fuel and oil for 200 miles

Shaft Turbine Powers Helicopter in Flight

Ralph P. Alex, Sikorsky Aircraft Division, United Aircraft Corp.

Based on paper "Helicopter Flight Experience with the Continental XT-51 Fixed Shaft Turbine," presented at the SAE Summer Meeting, Atlantic City, June 10, 1954

gines during vertical climb without payload. The turbine has greater range.

The gas turbine operates most efficiently at high speeds. As shown in Fig. 5, increasing speed from 50 to 100 mph will increase range with practically no increase in fuel consumption. Increasing speed 50% more will consume only 11 to 12% more fuel.

Also, as shown in Fig. 6, the faster the turbine-powered helicopter flys, the greater its range. To get maximum range using a piston engine it is necessary to fly at considerably less than maximum speed.

One disadvantage of a gas turbine installation is loss of power during hot weather operation. Approximately ½ of 1% power is lost for every degree Fahrenheit above 60 F.

Residual Thrust—There are 75 lb of usable jet thrust from the tail pipe. In the air, this offsets 15% of the total drag and increases speed accordingly. On the ground, this makes it possible to taxi the helicopter with the rotors stationary.

Engine Control—Engine speed and fuel feeding is automatically controlled by an isochronous governor. During operation, except starting or stopping, constant speed within 2% variation is maintained. This is a major simplification and relieves the pilot of constantly watching his tachometer during flight. The XT-51 has a high rotational inertia, considerably higher than the inertia of the rotor system. This helps maintain constant speed because large rapid changes in power necessary for the rotor system affect the turbine speed only slightly. In a piston engine the polar moment of inertia makes it impossible to develop a satisfactory speed control. The free shaft turbine presents similar problems in controlling speed.

Installation Weight—The installed weight of the turbine with all accessories is under 250 lb. The engine itself is considerably lighter than a piston engine of equal horsepower. Also, engine structural supports weigh less than 2 lb. Heavy accessories, such as a fan cooling system have been eliminated. Too, by mounting the turbine to the main box through a standard flange pad drive, transmission universal joints or spline couplings and shafts were eliminated.

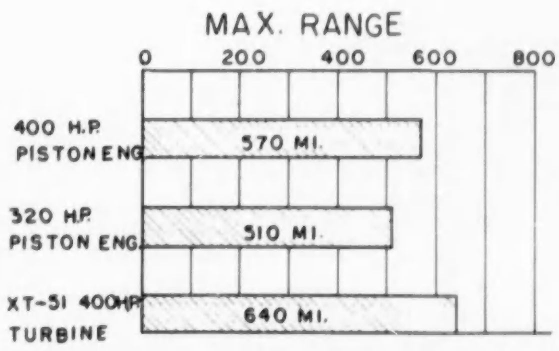


Fig. 4. Range comparisons of three type engines. At no payload, the turbine range was 640 miles. The minimum rate of climb for the three aircraft during test was 300 ft per min

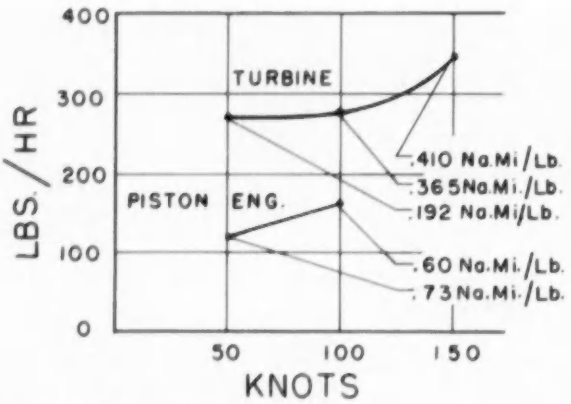


Fig. 5. Fuel consumption, speed, and range of the turbine and piston engines. The turbine used practically the same amount of fuel at 50 and 100 knots, although range was increased. An increase of speed from 100 to 150 increased fuel consumption almost 12%

Oil System—The oil system is simple and light in weight. Total oil capacity is less than 2 gal. There is negligible oil consumption and very little need for oil cooling.

Fuel System—A standard aircraft-type fuel system with a constantly operating booster pump is used. Because a gas turbine burns considerable amounts of fuel, the fuel tank capacity has to be more than doubled.

Any standard gasoline is satisfactory. JP-4 jet fuel and 91-96 octane gasoline was used during tests with no operating difference. The JP-4 jet fuel is more safe because it is less volatile. It also provides an 8% increase in range due to its heavier specific gravity.

Continuous use of highly-leaded fuels will cause lead oxide to deposit on the turbine blades and subsequently unbalance the turbine wheel.

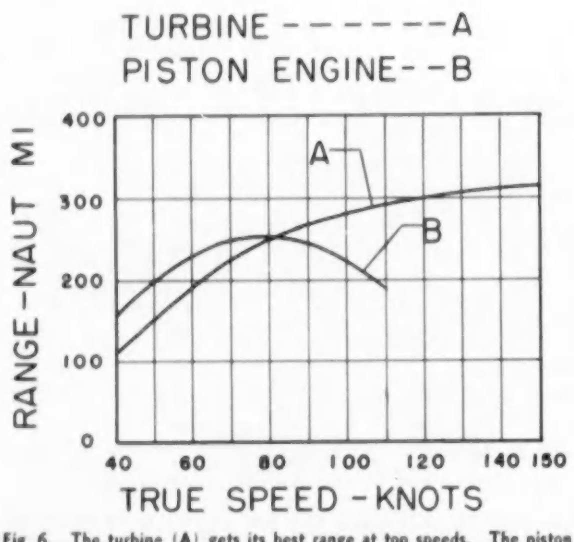


Fig. 6. The turbine (A) gets its best range at top speeds. The piston engine (B) gets maximum range at much less than maximum speeds

Parts and Accessories—Many parts and accessories that cause piston engines to fail have been eliminated, e.g., the carburetor, magnetos, connecting rods, valves, and spark plugs. This simplifies power plant design and lowers weight and cost. The elimination of the fan cooling system restores up to 9% power to the rotor which had been taken off to run the fan.

Vibration—The gas turbine runs with less vibration than a piston engine. This eliminates the high peak stresses in the transmission drive system and increases service life. Also, there are no critical speeds, particularly during idling. This permits lighter engine mountings and shock absorbers.

Noise—Noise level in the cabin and outside a 90 ft radius in all directions is less than 100 db. This has great influence on reducing pilot fatigue.

Ignition System—The low tension ignition system consists of a standard Bendix coil and two spark plugs. During tests, approximately 100 starts were accomplished with no cleaning required and no sign of ignition difficulties.

Instruments—The following instruments are installed in the S-59 instrument panel for controlling engine operations:

- Tail pipe temperature gage
- Oil pressure gage
- Fuel pressure gage
- Oil temperature gage
- Fuel quantity and totalizer
- Tachometer
- Fuel flow gage

Starting System—Starting is accomplished by an electric starter with power furnished by a standard aircraft battery. The ignition switch and starter trigger are on the collective pitch stick and operated by the thumb and forefinger. In starting, the fuel valve is manually operated to bring the engine up to speed and to engage the clutch. After this, control is pushed to wide open and the governor takes over.

The gas turbine starts easily and requires no warm-up. During tests the helicopter was airborne at 1000 ft altitude one minute after the pilot pressed the starter switch. Spending as little time as possible on the ground with the rotor running saves fuel and engine wear and reduces chances of accidents during loading and unloading. Also, upon landing the engine can be shut down immediately and the rotor braked to a stop within one minute.

Installation and Repair—Service tests of the S-59 helicopter with the XT-51 turbine are still pending. However, availability of this helicopter will be directly proportional to its speed. Since the engine is pod-mounted externally, it is accessible for repair. And its light weight and simplified accessories make it easy to install or replace.

Compatibility—From the above discussion it is evident that the XT-51 fixed shaft turbine is compatible with the rotor system in the S-59 helicopter. (Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Earthmovers Take to Hydrostatic Transmissions

H. V. Parsley, assistant division chief engineer,
Advanced Engineering Group, International Harvester Co.

Excerpts from paper, "Hydrostatic Transmission in Earthmoving Equipment," presented at the SAE National Tractor Meeting, Milwaukee, Sept. 14, 1954.

THERE seems to be a trend to the increased use of hydrostatic transmissions in earthmoving equipment. I believe the cost and weight of these units will be decreased as production is increased and higher pressures are accepted. Other factors increasing this use are (1) the trend to special-purpose earthmoving machines to reduce the cost of moving material and (2) the increased emphasis being put on operator's comfort.

The hydrostatic transmission employs positive-displacement pumps and motors of the gear, piston, or vane types to circulate the oil in the system. Power is transmitted by causing a pressure rise in the pump and a pressure drop in the hydraulic motor. Since the oil returns to the pump with the same velocity with which it left, there is no kinetic energy transfer, so the system is called hydrostatic.

Fig. 1 shows a comparison of hydrostatic and hydrokinetic transmissions. The hydrostatic transmission curve follows more closely the theoretical perfect torque converter curve than the hydrokinetic transmission curve does, especially at the higher torque multiplication end. From an efficiency standpoint this transmission has several advantages over the hydrokinetic transmission for some applications.

A hydrostatic transmission has the following typical advantages compared to mechanical and hydrokinetic transmissions:

1. Extreme flexibility in installation, the power may be transferred to some inaccessible place through tubes or flexible hose.

2. The transmission may be preset or varied under load to maintain practically any speed ratio through wide variations in torque.

3. The transmission may be reversed or idled by means of a simple 4-way valve.

4. Precise control, as far as speed and travel are concerned, is obtained.

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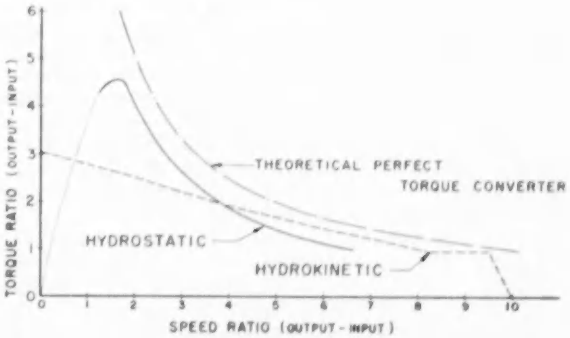


Fig. 1—Comparison of hydrostatic and hydrokinetic transmissions

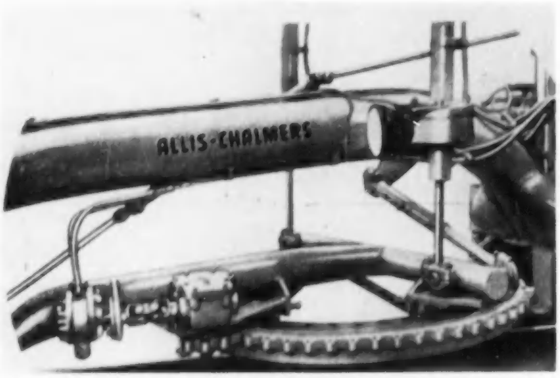


Fig. 2—Hydrostatic transmission used to rotate road grader blade

Fig. 3—Ditching machine uses hydrostatic transmission to propel machine while digging

5. Smooth, uninterrupted variations in speed and torque ratios, and overload and shock protection are readily obtained.

A hydrostatic transmission has the following typical disadvantages:

1. High thrust and radial loads on its bearings.
2. High stresses in some of its other parts.
3. The necessity for extreme accuracy in machining.
4. Difficult sealing problems.
5. Relatively high weight and cost.

One of the primary advantages of the hydrostatic transmission is its extreme flexibility of installation. A good example is the use of this type of transmission to control the angle of the blade on road graders (Fig. 2). Allis Chalmers, on their model D grader, use a gear-type motor with a theoretical torque of 50 in.-lb per 100 psi driving through an 18 to 1 worm gear to a 60 to 1 ratio in the circular rack and pinion. The overall reduction between the motor and circle is 1080 to 1. The source of power, the hydraulic pump mounted on the engine, is a considerable distance from the blade operating mechanism. One other advantage of this type of transmission is that the same source of power can also be used to perform other functions such as front wheel tilt and control of blade depth. Several road grader manufacturers use this method of control on their road grader blades.

The output speed of a hydrostatic transmission can be infinitely controlled between zero and maximum rpm by controlling the amount of oil flowing to the hydraulic motor. The direction can be reversed by a simple 4-way valve. The Barber-Greene Co. takes advantage of these features by using a hydrostatic transmission in their model 705B Runabout service ditcher (Fig. 3).

A hydraulic pump and motor are employed, in combination with mechanical power, to develop an improvement in a ditching machine. The hydraulic power arrangement is a supplement to the normal mechanics of power drive, through engine, transmissions, clutches, and gear changes. In a trenching machine, for example, 90% of the engine power is necessary to drive the digging element through the soil and to excavate, whereas only 10% is required for tractive effort, or crowd (a term used to denote traction power to force the digging element in a horizontal plane).

For many years there has been a need for means to coordinate better, with flexibility, the traction speed and the feet per minute speed of the digging element. In a normal machine with one engine and master transmission, which powers other gearboxes, or drives, it is very difficult to acquire correct speeds for all soil conditions, various depths, and moisture factors. The normal irritating experience of searching for the correct gear ratios results in inefficient operation and less economy per foot of trench.

Hydraulic-powered traction effort (called Hydra-Crowd) was developed by Barber-Greene to eliminate the gear-shift problem and in so doing attained other notable features (Fig. 4): for example, flexibility for all speeds between minimum and maximum, fixed maximum power as defined by psi setting relief valve; Effortless control, ease of understanding, quick reverse to get relief from obstructions, independent of speed of digging element.

Therefore, by the manipulation of two small levers full control of the trencher has been accomplished, fast and understandably:

1. The engine governor lever by decelerating or accelerating the engine rpm, to pick up a load or ease off to neutral through the fluid coupling.

2. The flow control lever in the hydraulic system for hydraulic drive corrects the ground wheel speed

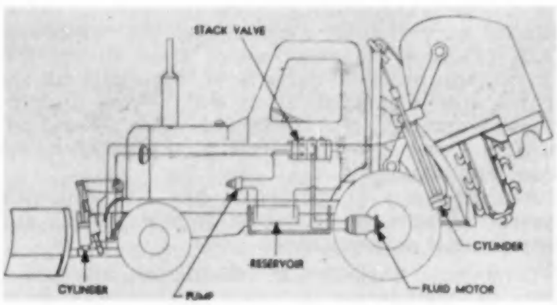


Fig. 4—Hydraulic diagram on ditching machine

to suit the soil conditions or load applied to balance the digging element power capacity.

Compare this to many clutch action movements, many gearshifts of questionable ratios to obtain similar results with a fully mechanically driven machine, and it will be noted that much time and effort are saved.

Hydraulic power has proved to be a convenient advantage when added accessories are desirable (Fig. 5). Extra valves were added in the circuit to control a bulldozer blade on the front of a trencher, a hydraulically driven conveyor has been used to replace a mechanically powered conveyor, and power steering has been added. This flexibility is very helpful in the overall production costs and convenience.

Unimatic Corp. uses the inherent advantages of hydrostatic transmission to design a unique ditcher for mounting on a crawler tractor (Fig. 6). This machine is unique in that all power is supplied hydraulically. The forward and reverse digging speeds are controlled by their Unimatic drive, which makes dual use of the tractor transmission. The tractor may be operated in the conventional speeds and then, by disengaging the master clutch and engaging the Unimatic drive, the track speed is reduced. This is accomplished by driving the tractor power-take-off through suitable gear reduction with a Vickers 200 series motor. A flow control valve is used to control the flow of oil to the motor to obtain infinitely variable speeds within the range of the transmission gears. The digging speeds are infinitely variable between 0.33 to 26.4 fpm and reverse from 0.37 to 9.3 fpm, depending on oil flow to the hydraulic motor and transmission gear selected. In addition to using the hydrostatic transmission to provide motion for digging, the unit also uses the hydrostatic transmission to operate the digging wheel, to control digging depth, and to operate the conveyor. Therefore, all operations of the ditcher have accurate overload protection provided by the relief setting of the pressure relief valve.

The same source of power is also used to control the bulldozer. The unit can be removed or installed by one man in 30 min. This is made possible by the fact that the power connection between the units consists of hydraulic hoses, which are easily connected and disconnected. As the unit is 100% hydraulically controlled, the effort required to operate is at a minimum.

Fig. 5—Ditching machine with additional hydraulically operated equipment

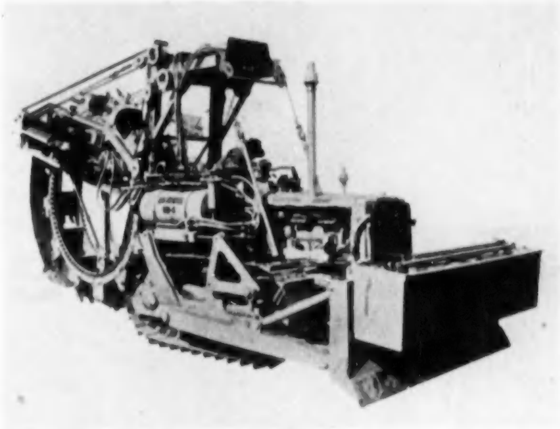


Fig. 6—Complete hydraulically operated and controlled pull-type ditching machine

Fig. 7—Hydraulic crane incorporating many inherent advantages of hydrostatic transmissions

Austin Western has carried their experience with hydrostatic transmissions in the road grader and military crane field into a commercial crane (Fig. 7). This crane utilizes nearly all of the inherent advantages of hydrostatic transmissions.

Hydraulic power from one pump is used to rotate the crane upper-structure by the use of piston-type oil motors of their own design, is used to operate the hoist drum by use of a vane motor to drive the hoist drum through a cone worm-gear drive, is used to elevate and lower the crane boom by the use of a piston, and extends and retracks the boom by the use of a piston. All of these controls are grouped in one bank for easy access to the operator. Maximum hoisting capacity is easily controlled by the psi setting of the relief valve, thereby protecting the machine from dangerous overloads. This is a very easy crane to learn to operate. It goes a long way towards taking the work out of crane operation. As there are no clutches and brakes to slip, the inherent, precise control available in hydraulics can be used.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

There's Lots New

EXPANDING use of welding has come with the development of better methods and equipment, designed to produce high-quality welds at a satisfactory cost. The following three phases will be discussed here:

- Resistance welding.
- Welding equipment and processes.
- Arc welding electrodes.

THE material on welding contained in this article is based on a panel discussion by the following experts:

Leader:

G. F. Meyer, district manager, Machinery & Welder Corp.

Secretary:

Peter Stern, Reynolds Metals Co.

Panel Members:

John Randall, supervisor, welding development, Ford Motor Co.

J. B. Welch, process and manufacturing engineer, Cutler-Hammer, Inc.

R. Clements, director of research, Arcrods Corp.

F. E. Garriott, manager, weld rod and wire department, Ampco Metal, Inc.

W. L. Palmer, industrial engineer, Deere & Co.

C. C. Hart, welding consultant

M. W. Hippe, manager, engineering, service, Linde Air Products Co.

Resistance Welding

Resistance welding is expanding at a greater rate than any other welding process. This growth is a heartening indication that resistance welding has reached the point where it is accepted as an economical production tool capable of producing welds of the highest quality. Until recently, resistance welding was considered the poor relative of the other welding processes because it was thought to be a haphazard metal-joining medium.

One of the greatest crimes against the good name of resistance welding is the purchase of a cheap or underpowered machine without the control features necessary to produce quality welds. There is a tendency in all but enlightened managements to cut all corners when it comes to the purchase of resistance welding equipment, whereas these same managements will unhesitantly expend large amounts for machine tools. Contrary to common belief, a well-designed resistance welder is a true precision tool.

In any of the resistance welding areas, seam welding, spot welding, percussion welding, projection welding, and flash welding, the machine must be designed for performance, generally, within a small area of operations. The possibility of the control of the pressure cycle and follow through must be part of the machine design and if it is not properly designed there is little the operator can do to set the machine up properly for a new operation. Proper machine design must be purchased! Manufacturers of resistance welding equipment are becoming more and more aware of the part that design plays in the ultimate use of their equipment. For instance, they know that too slow a follow through will cause a cast structure in the weld nugget, with metal expulsion, and too fast a follow through will require a larger machine than necessary to produce a given weld.

The engineer who is designing resistance welded parts must have intimate knowledge of the equipment that will produce the weld, so that he will be able to design parts so as to take advantage of the

in Welding

Peter Stern, Reynolds Metals Co

Excerpts from secretary's report of panel discussion on "Welding—What's New?" held as part of the SAE Tractor Production Forum, Milwaukee, Sept 13, 1954

best features of resistance welding while avoiding any limitations that may be present. When the carbon content of plain carbon steels exceeds 15 points, spot welds will no longer have maximum ductility unless they receive subsequent heat-treatment, either within the machine or externally. On the other hand, it is possible, in certain cases, to flash weld steels with up to 55 points of carbon without preheat or postheat. In flash welding, the use of preheat, however, can effectively increase the capacity of the machine. In designing for resistance welding it is necessary to take into account not only the material composition but the material thicknesses and conditions. While thicknesses of up to one inch have been successfully spot welded, 5/16-in. thickness for the thinnest piece is considered a heavy spot weld. The ratio of the thickness of the thickest piece to the thickness of the thinnest piece should not be over 3 or 4 to one. Of the utmost importance in producing successful resistance welds is the cleanliness of the material, this is of such importance to quality, it might be well, in specific cases, for the engineer to specify material condition on the drawing.

Close cooperation between industrial engineering, supervision, and inspection is necessary to reap the cost saving harvests available through resistance welding. Detailed welding schedules cannot be made in advance. Through the use of published welding schedules as a starting point, industrial engineering and supervision can set up the machines for a given operation. It is because each machine is different that predetermined schedules cannot be used successfully. Inspection has the difficult job of determining if the quality standards have been met. Because no really effective nondestructive test has yet been devised, for the highest quality parts it might be necessary to test to destruction as many as 2% of the pieces produced to assure a given quality level. As the quality requirements are reduced simpler tests can be used, such as torque test or peel test. In planning and processing jobs the cleanliness of the parts must be kept in mind. Pickled and lightly oiled parts produce the highest quality spot welds; however, if there is an appreciable delay after the production of the parts and before they are incorporated in a finished assembly, so that they gather rust or dirt, they must be processed again. Three methods of cleaning may be used; pickling, sand blasting, and power wire brushing. It should be remembered that, while the skill required of the resistance welder operator is low, the skill required of the laborer who sets up the machines is very high, so that he becomes an important part of the successful resistance welding "team."

Welding Equipment and Processes

This discussion will be limited to various aspects of automatic and semiautomatic, submerged arc welding, inert gas shielded metal arc welding with tungsten electrode (tungsten arc welding), and inert gas shielded metal arc welding with consumable electrode (consumable electrode welding). Automatic welding can be defined as welding where all the factors such as arc voltage (arc length), current, wire feed, travel speed, and direction are maintained at a preset level without manual manip-

ulation. In automatic welding operations the loading and unloading of the machines may be either manual or automatic. Semiautomatic welding can be defined as welding where one or more, but not all of the factors listed above are maintained at a preset level without manual manipulation and the rest of the factors depend on the manual dexterity of the operator.

Submerged arc welding uses a bare metal electrode, which is power fed into a blanket of flux that is deposited on the seam to be welded. Because the arc is completely submerged the welds are exceptionally smooth and free of spatter. The flux adjacent to the arc melts, floats on the surface of the molten metal, and then solidifies to form a slag on top of the weld. Since the molten metal is blanketed by flux at all times the weld is completely protected from contact with the air, assuring the highest quality weld metal. In automatic submerged arc welding the modern practice is to use a maximum electrode diameter of 5/16 in., with the bulk of that being used in the range of ⅛-in. diameter to 3/16-in. diameter. Welding currents used in automatic submerged arc welding may range from 200 to 1500 amp. In semiautomatic submerged arc welding the electrode (⅛-in. max diameter) is pushed through a flexible tube to a holder that contains a flux hopper. After setting the current and the wire feed (which establishes the arc voltage by self-regulation) the operator imparts the direction and speed to the holder, currents up to 650 amp are used with the semiautomatic submerged arc welder. Submerged arc welding is used on steels up to a medium carbon (35 points) and low alloy steels. It can be used successfully on stainless steels. With automatic setups, submerged arc welding can be performed on material from approximately 0.045 in. thick to extremely heavy sections.

Inert gas shielded metal arc welding with tungsten electrode (tungsten arc welding) uses the heat of an arc, surrounded with an inert gas, established between a suitable holder and the piece to be welded. Welding can be performed with or without the addition of filler wire. The inert gases used are helium (99.9% pure) and argon, or a mixture of the two. Tungsten arc welding can be used for almost all ferrous and nonferrous welding from 0.010 in. in thickness up. While very heavy sections have been welded by this process, particularly in aluminum, it is usual to limit this process to single-pass work up to approximately 3/16 in. in thickness. By far the greatest portion of tungsten arc welding is manual, but there are considerable numbers of automatic installations and a few semiautomatic (filler wire power fed) installations.

Inert gas shielded metal arc welding with consumable electrode (consumable electrode welding) is similar to tungsten arc welding. Instead of a tungsten electrode, which is not consumed in the arc, this process uses a metal electrode, which is consumed in welding. The transfer of material through the protected arc increases the thermal efficiency of the process by carrying heat to the workpiece. This does not occur in the tungsten arc process. The result is to permit very rapid welding. It is usual in the automatic installations of a consumable electrode welding to use an arc voltage control, while the semiautomatic machines depend on self-regulation to maintain the correct arc length. A wide variety of gases and gas mixtures are used in consumable electrode welding: argon; helium; argon and oxygen (1 to 5% O_2); helium and oxygen; argon and helium; argon, helium, and oxygen; and carbon dioxide. The picture is changing so rapidly that it is possible to make only a general statement concerning the use of various shielding gases. On nonferrous materials argon and helium, and mixtures of the two, are used. On stainless steels, low alloy, and plain carbon steels argon and oxygen, helium and oxygen, and mixtures of the two, are used. Carbon dioxide is used on mild steel. Consumable electrode welding is usually used on material thicknesses from 0.060 in. to 1½ in.

Where there is an overlapping of applications for the submerged arc, tungsten arc or consumable electrode process selection is usually based on total overall per piece cost.

Arc Welding Electrodes

This discussion will be devoted to contact electrodes. While contact electrodes are not new, they are just becoming widely used. The term "contact electrode" is actually a misnomer since it can be used successfully with a free arc. The electrode can be described as very heavily covered electrode with powdered iron in the covering and a relatively small core wire. The proposed American Welding Society classification for this electrode is the E-6024. Typical composition and physicals for the proposed E-6024 are:

Carbon, %	0.068
Manganese, %	0.86
Phosphorus, %	0.014
Sulfur, %	0.019
Silicon, %	0.78
Vanadium, %	0.08

Ultimate Tensile Strength, psi	80,000
Yield Strength, psi	71,800
Elongation in 2 In., %	19.0

The physicals were obtained after aging.

As a matter of interest it has been found that aging of the weld metal will produce a very marked improvement in physical properties. This aging may be either artificial (10 hr at 220 F) or natural (10–14 days). In weld metal quality and fields of application the proposed E-6024 is very similiar to the E-6012 which is familiar to most people. Although the proposed E-6024 electrode is more expensive than the E-6012 electrode (by approximately 20%) if it is properly used it is possible to effect a considerable saving in the production of a weldment.

The principal advantages of the proposed E-6024 are: low spatter, high linear speed, ease of handling, ease of slag removal, and high disposition rate. It has been found that for best results with this electrode at least some welder training is indicated.

One can look forward to the expanded use of the contact electrodes and the creation of new classifications for wider applications.

(The report on which this article is based is available in full in multilithographed form, together with reports of six other panel sessions at the SAE Tractor Production Forum, Milwaukee, Sept. 13, 1954. This publication (SP-308) is available from the SAE Special Publications Department. Price: **$1.50 to members, $3 to nonmembers.**)

Good Brakes Are Not Enough

J. G. Oetzel, Warner Electric Brake & Clutch Co.

Based on paper "When are Brakes Adequate?" presented at the SAE Summer Meeting, Atlantic City, June 7, 1954, and discussion by C. W. Johnson, General Motors Corp., Clyde S. Batchelor, Raybestos-Manhattan, Inc., and A. H. Easton, University of Wisconsin.

BRAKING a vehicle safely depends on a lot more than just the ability of a brake to lock its wheel. The heat and torque capacity of the brake, the condition of the road and tires, the distribution of load, and the ability of the driver are equally important factors.

Let's review briefly the principles of automotive brakes as background for our discussion of these variables.

Brakes are Energy Converters

Automotive brakes stop a vehicle by using the force of friction to overcome motion. The turning brake drum (and wheel) is slowed by applying a non-rotating brake shoe against it. The ensuing friction transfers the kinetic energy of the wheel into heat energy. This is dissipated into the surrounding air and the wheel is slowed to a stop. The following affect the ability of a brake to stop a vehicle:

1. Speed and Load

The greater the speed and the heavier the vehicle, the more energy is needed to brake the vehicle. Many communities have legislated brake standards. One current law requires that a passenger car be brought to a stop from a speed of 20 mph within 30 ft. A Bureau of Public Roads survey found that the average car could do it in 22.75 ft, 85% could do it in 28 ft. But new cars are increasing in weight, have higher speeds. The old stopping criterion no longer holds, particularly with multistaged trucks coming into greater use.

2. Road-tire Contact

Tire and road conditions can be discussed together because we are here concerned with the ability of the tire to grip the road. Tread design, tire deflection, and load on the tire will influence adhesion to the road. Obviously, a new tire with good tread design gives greater coefficient of friction than a smooth tire.

The coefficient of friction between the road surface and tire is higher while the wheel is turning than it is during the slide. The oscillograms in Fig. 1 show how tire-road coefficient changes as brake torque is built up to lock the wheel and then release

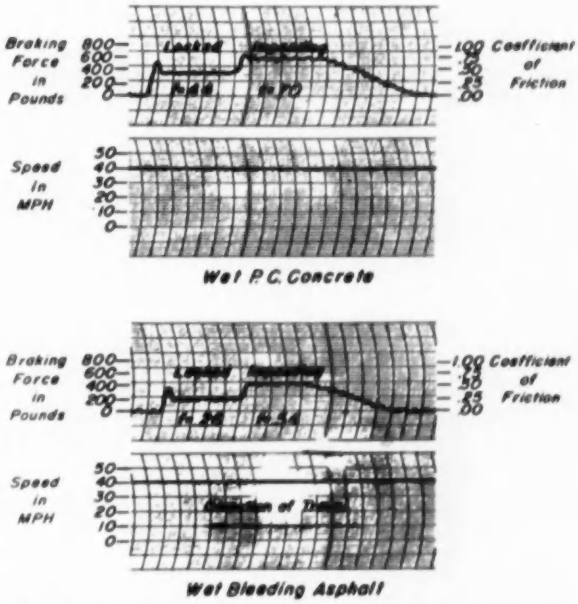


Fig. 1—This oscillogram shows how tire-road coefficient changes as brake torque is built up to lock the wheel and then release it. Braking to a point just short of locking gives maximum deceleration

it. Braking to a point just short of locking gives maximum deceleration.

Of course, the coefficient of friction differs with various types of road surfaces. And ice or water will help the car to skid. Another road condition, which is not often recognized, occurs just at the start of a rain storm. For about five minutes the surface of the road is covered with oil, road sludge and rain water in critical amounts which form an emulsion slippery as ice. As the rain continues the oil slick is washed away.

3. Load Distribution

The load of a vehicle is usually distributed over all the wheels. That's why most vehicles have brakes at each wheel. But the percentage of distribution of load is different if the vehicle is fully loaded than if it's empty. Front wheels tend to lock and skid at full loads; the rear wheels skid easily when the car is empty. Sometimes too much load on the front wheels will impair steering. So, brake pressure applied to each wheel must be balanced to account for load variation and weight shift.

4. Weight Shift

When brakes are applied there is a shift of weight from the rear to the front wheels during deceleration. The front and rear wheels no longer carry equal loads. If the center of gravity of the car is high, a force couple is produced between the retarding force at the tire-road contact and the inertia force acting at the center of gravity. This tends to depress the front end of the car and lift the rear end. That is, add weight to the front end and reduce weight at the rear wheels. Brakes are usually balanced to counteract this, giving the front wheels a higher percentage of the braking job.

On tractor trucks, the rear wheels are usually given the higher percentage. This helps steering down slippery, winding hills with full load. But on long hills this may cause rapid wear and high maintenance costs. Also, if a tractor wheel locks, the trailer may jacknife into the tractor.

Ideally, the front brakes should be designed to take more of the braking effort as the weight shifts to the front. But this is not feasible because wheels develop their maximum friction at one rate of deceleration.

5. Braking Capacity

Brakes must perform two distinct functions in a motor vehicle. In emergencies they must stop the vehicle in the shortest possible distance. In normal operation they must retain control of the vehicle when descending long hills. The former requires large braking torque applied to brake drums. The latter calls for brakes that can dissipate large quantities of heat without large temperature rises.

At high speeds when a brake is applied, the rubbing speed between the drum and the shoe may be so high that it builds up heat rapidly—more rapidly than it can dissipate. This increases the brake lining surface temperature and decreases its coefficient of friction.

Fig. 2 illustrates that as the rubbing speed decreases, the rate of heat build up is decreased, the surface temperature becomes lower and the coefficient of friction is increased. This enables the brake to slow the car down. Sometimes the coefficient of friction is not recovered completely until after a complete stop.

When operating the brakes constantly, even at low speeds, as when going downhill, so much heat can be accumulated that the surface temperature is raised. This reduces the coefficient of friction and the brakes are said to "fade."

Some brake linings have higher friction when cold. Others have better friction characteristics when slightly warm.

Assuming that we have a brake lining that can dissipate heat fast enough to prevent getting hot and fading, there is still the problem of wheel lock. When a wheel is braked completely it slides along the road instead of rolling. Actually the car jumps forward a little at this point as shown in Fig. 3. As

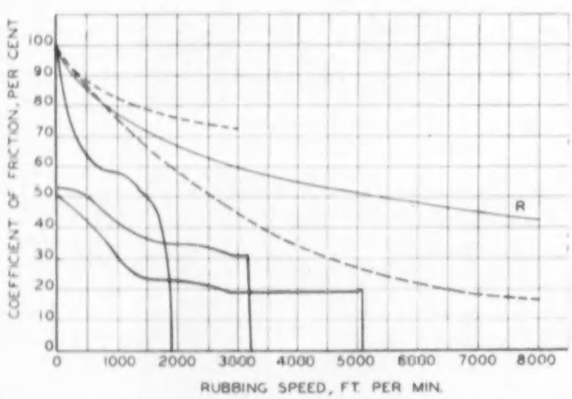


Fig. 2—As rubbing speed decreases the coefficient of friction is increased. This is because the rate of heat build up is decreased and surface heat has a chance to dissipate into the air. Line R is the generalized relation between coefficient of friction and rubbing speed (steel on steel). Two dotted curves represent resin-bonded lining on alloy cast iron

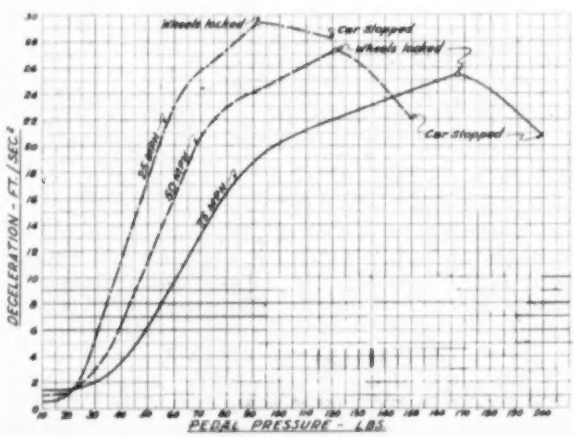


Fig. 3—Deceleration before and after locking wheels at 25, 50 and 75 mph. New tires on dry concrete surface

the brake is applied the car decelerates at an increasing rate until the wheel locks. Then its deceleration rate decreases slightly.

6. The Driver

We see that brakes can be made mechanically adequate for normal driving conditions. At the high speeds on today's highways, the adequacy of the driver takes on new importance. The driver's skill and reaction time and ability to anticipate accidents is as vital a factor in preventing accidents as good brakes. (Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Helicopters . . .

. . . will be adopted by airlines for short-haul as soon as economics will permit. Studies indicate general use is still remote despite enormous progress in helicopter development.

Based on paper by **W. L. McMillen,** American Airlines, Inc.

THE scheduled airline is intensely interested in the possibilities of the helicopter in the flight range of 100 to 250 or 300 miles. Most of the short-haul passenger travel of American Airlines is carried on the 2-engine airplanes of high relative efficiency. Yet each year American loses a lot of money in short-haul operations.

The nature of our costs resembles those of bus companies. If we attempted to charge the short-haul passenger in accordance with the cost of his transportation, there would be practically no short-haul passengers. But the short-haul also produces, by connection, some long-haul traffic which is profitable. We have a public responsibility to provide short-haul as well as long-haul service.

We have people pointing to an annual 300 million passengers carried less than 50 miles by present common carriers and 90 million going 50 to 100 miles. They point out that the airplanes get practically none of this business, but that the helicopter will eventually get a large slice of it. Well, let's see. The Air Transportation Association has suggested a helicopter with the payload capacity of the Convair (about 7500 lb) and with comparable per mile costs. American's direct flight expense for the Convair is about 78¢ per revenue mile. Los Angeles Airways reported a direct cost of $1.83 per revenue mile for the S-55 with a reported payload of 1060 lb. New York Airways reports a comparable figure.

Using this reported figure and making adjustments to place the S-55 in a comparable type of operation, it might be possible that in an airline operation of distances above 100 miles the S-55 per mile direct cost would be about 78¢, or comparable to the Convair (Table 1.)

While the reported payload of the S-55 is only 1060 lb, an increase to about 1400 lb may be possible in the near future by operating with a gross weight of 7200 lb instead of 6835. This brings the direct flight cost per available ton mile down to about $1.12, or 11¢ per seat mile. This is about 5 times that of the Convair.

Total operating expense, including ground expense, then would be about $2.00 per available ton mile, 20¢ per seat mile and over 30¢ per passenger mile. The adjustments made are rather generous ones in that I believe it will be many years before a sizeable fleet will achieve 6 hr daily utilization. Short-haul and low utilization go together. Also, there is some doubt about getting the 1400-lb payload in high summer temperatures, or regardless of temperatures, on hops approaching 200 miles.

More light can be thrown on the problem by considering a manufacturer's estimates for a hypothetical 30-passenger helicopter. They assume a cruising speed of 140 mph with a block speed on longer hops of 135 mph. Payload is estimated at 6000 lb and the selling price at $600,000. The direct flight cost per hour adjusted, with the manufacturer's approval, to current airline price and wage levels, and with insurance estimates decreased, comes to $203.

Because of experience with hypothetical costs I have taken the liberty of adding 10% for contingency, but I do not wish to infer that 10% is adequate. This brings a direct cost of $223 per hour which, in turn, is $1.65 per mile and 5.5¢ per seat

TABLE 1—Direct Flight Expense

	Col. 1 S-55 as Reported	Col. 2 S-55 as Adjusted	Col. 3 Hypothetical 30-Passenger Helicopter	Col. 4 DC-3	Col. 5 Convair-240
per revenue mile	$ 1.83	$ 0.78	$ 1.65	$ 0.52	$ 0.78
per revenue hour	133.00	57.00	223.00	77.00	128.00
per available ton mile	3.47	1.12	0.55	0.22	0.21
per revenue ton mile (at 65% load factor)	5.30	1.72	0.84	0.34	0.32
per seat mile (200-lb unit)	0.35	0.11	0.055	0.022	0.021
per passenger mile (at 65% load factor)	0.53	0.17	0.084	0.034	0.032

Note: Average daily utilization in Columns 2-5 is approximately 6 hr. (That in Column 1 is 2 hr 41 min.)
Average hop in Columns 2-5 range from 70 to 170 miles. (That in Column 1 is 11½ miles.)

mile. Assuming a 65% load factor, the direct cost per passenger mile would be 8.5¢. If we add ground expenses of 3.5¢ as calculated, we arrive at total operating costs of about 12¢ per passenger mile, (or 14¢ on trips under 100 miles.) See Table 1.

At an average hop of 165 miles American's Convair direct flight costs are about 2¢ per seat mile. The cost would be a little higher if depreciation charges reflected the current price of new aircraft. This means that with a 30-seat helicopter with block speed of 135 mph, the cost per hour must be between $85.00 and $95.00. Compare this with the minimum $223 per hour flight cost of the future hypothetical 30-passenger helicopter and one sees how far we have to go to meet the ATA Committee objective. (Paper "An Air Line View of the Helicopter" was presented at SAE Annual Meeting, Detroit, Jan. 14, 1954. It is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Air Conditioning . . .

. . . for jet transports must be an improvement on present systems used in high speed pressurized transports. Good practice is known but approach varies and end results show deficiencies.

Based on paper by **Charles Perry, A. F. Bullard and O. E. E. Anderson,** United Airlines, Inc.

AIR conditioning for jet powered transports will not require far different design end results than that required for present day high-speed pressurized transports. The system should be based on good design practices already well known to both the design groups of the manufacturers and of the airline operators.

As yet, no manufacturer or airplane model has presented a system fully satisfactory to the operator from all aspects of a good design. And by good design is meant one that excludes the need for extensive modifications and extensive maintenance.

Among the basic requirements is a ventilating system that will provide circulation of adequately conditioned air at a rate of not less than 2.5 lb/min (32 cfm, approximately) per passenger during all normal flight conditions, or 1.5 lb/min (19 cfm, approximately) under limited operating conditions. Conservation of pressurizing air would be much easier with the use of a re-circulating type air conditioning system.

One of the most feasible jet transport pressurizing systems seems to be one using two or more cabin air compressors powered pneumatically. We believe this to be so because of its greater simplicity from a mechanical and control standpoint. Our limited information indicates that constant speed drives for prime mover driven compressors has proved costly in maintenance and reliability. It is likely that a specialized constant speed drive system would have to be developed, even though the present alternative drive has been in use for some time. (Paper "Airline Requirements of Air Conditioning a Jet Transport" was presented at SAE National Aeronautic Meeting, New York, April 13, 1954. It is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers).

Based on Discussion . . .

R. C. Hitchcock, Boeing Airplane Co.

A normal ventilation requirement of 2.5 lb/min/passenger would probably dictate a recirculating system because of the penalty in providing this much fresh air directly, at jet transport cruise altitudes. Recirculation is far from an ideal answer because of the initial cost, weight, space, complexity, and maintenance problems. Caution must be exercised in selecting a design ventilating rate. Too high a value can result in an inferior basic airplane design.

The use of two or more pneumatically powered cabin air compressors is admittedly a practical and reasonable way to do the job, but it is not simple and it can involve a great amount of money. The simplest, lightest, cheapest and most reliable source of jet cabin pressurization is engine compressor bleed.

Mark H. Smith, American Airlines, Inc.

We feel that upwards of 2.3 lb/min/passenger will provide a suitable ventilating rate.

We advocate cabin compressors—not main engine bleed. The information we have collected indicates to us that risk of contamination is too great and the state of filter design too young to gamble today on direct bleed.

At least three and preferably four cabin compressors should be used in order to assure adequate safety and to enable high utility by permitting clearance with 1-2 superchargers inoperative. Compressors should be driven by turbines actuated from main engine compressor bleed. We believe single stage cabin compressors are feasible.

George A. Lemke, Consolidated Vultee Aircraft Corp.

Ventilation at the rate of 2.5 lb/min/passenger represents "overdesign" of the air conditioning system by more than 100%. Pressurization at high altitudes represents a considerable horsepower requirement and any overdesign is extremely costly in airplane weights as well as engine performance.

Present aircraft maintain adequate ventilation without recirculation at approximately 1 lb/min/passenger. The quality of ventilation is primarily a function of the distribution system rather than of the total amount of air circulated.

Memo:

To: Fuel Researchers

Subject: Watch Exhaust-Valve Life When Studying Additives

A. E. Felt, R. V. Kerley, and H. C. Sumner,
Ethyl Corp.

Excerpts from paper, "Fuel Additives and Engine Durability," presented at SAE National West Coast Meeting, Los Angeles, Aug. 18, 1954.

OF the many items that affect engine durability, exhaust-valve life is one of those that needs closest attention when new fuel additives are being studied. For this reason, a series of graphs will be used to show the effect of several variables on exhaust valve life with various fuel additives. (It is obvious, of course, that the effect of an additive on all the other factors—wear, exhaust-valve lash loss, fuel and oil economy, and many more—would also have to be checked. Only then could the additive actually be marketed with assurance that its overall behavior would be beneficial.)

The variables to be discussed—which were studied during the investigation of additives proposed for the alleviation of spark-plug and surface-ignition difficulties—are as follows:

1. Engine and operating conditions.
2. Exhaust-valve material.
3. Additive concentration.
4. New versus used cylinder heads.
5. Number of tests.

Engine and Operating Conditions

Fig. 1 shows what different results can be obtained when one fuel additive is used in several engines, and in both dynamometer and road tests.

Note in this figure how engines of makes F2 and

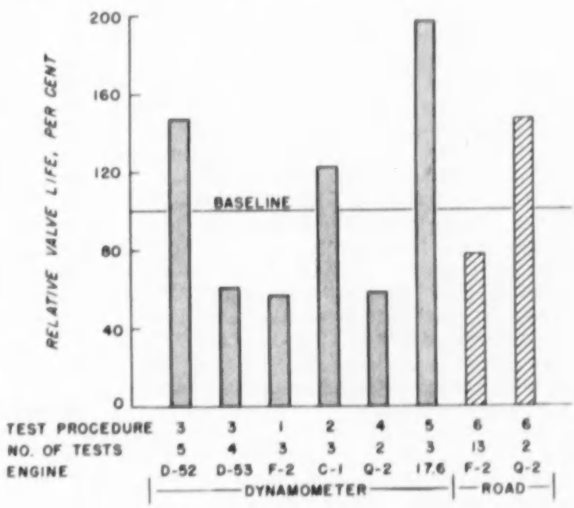


Fig. 1—Effect of engine and operating conditions on exhaust-valve life with one fuel additive

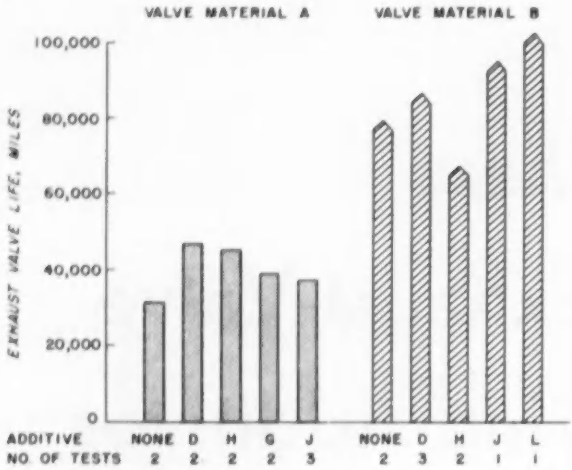


Fig. 2—Effect of exhaust-valve material and fuel additives on valve life; severe-duty road tests, car make Q2

Q2, in the two vehicles for which they were designed, reacted quite differently to the same additive when operated on identical road test schedules using the same fuel and oil. The importance of selection of engine make and test conditions on results is further illustrated in this figure. Two models of engine D operated on the same dynamometer schedule behaved quite differently. Engine Q2 showed a relatively low valve life in dynamometer tests as compared to the same model engine operated in the vehicle on the road.

This graph illustrates quite well that selection of engine alone is important, but that it is also important to select proper test conditions. It also shows that three of the engine-test condition combinations selected for dynamometer evaluation agree in direction and magnitude with vehicle Q2 and three combinations agree with vehicle F2.

The engines selected for tests should have design features representative of a large number of engines and they should have representative durability characteristics. It is hopeless to attempt spark-plug fouling tests on engines which do not normally experience spark-plug fouling in the hands of the owner. A considerable expense may be involved in conducting exhaust-valve tests in an engine which field experience indicates to be essentially free of valve trouble. It is, unfortunately, true that the ill effects of fuel additives are usually found where exhaust-valve life is already short. It is also true that additives to increase valve life generally show up best under these same circumstances.

One of the exasperating problems in the selection of engines arises in the engine production line itself. Rapid improvements in engine production practices and rapid changes in individual parts are most likely to occur when a new design is first put into production. However, engineering changes are continuously being made and any assumption that all the engines in a group are alike because they came off the assembly line in consecutive order is likely to be wrong. It is necessary to disassemble engines prior to their use if wear measurements are to be made. Even though these measurements are not made, a pretest inspection should be made. During the past year, pretest inspections have been made on five different makes of engines and differences from engine to engine have been found within each make. These differences were sufficiently important to influence test comparisons. These production-line variations included differences in valve steels, changes in exhaust-valve springs, and improper fitting of exhaust-valve-seat inserts.

Exhaust-Valve Material

The effect of valve materials on durability is well known. It is of interest to note, however, that engines coming off the assembly line at one time might have been equipped with valves made from either of two types of materials. A casual examina-
the production valves were marked identically. Fig.
tion would not have shown this difference because
2 illustrates the effects of five different fuel additives on valve life in car make Q2 using these two different valve materials. It is obvious that none of the additives tested has had any deleterious effect on valve life in these vehicles and it is indicated that this make of vehicle also has excellent valve life for this type service with either valve material. For the data shown here, valve life is expressed as mileage to the first valve to fail out of each set.

It is our feeling that careful inspection of exhaust valves prior to use is a very desirable control to avoid random failures whenever possible. As of about a year ago, half of the exhaust valves for one make of engine were rejected because they did not meet laboratory inspection standards. This is not an indication that the rejected valves are unsatisfactory for normal use. It is an indication that preference is given to throwing away questionable production valves in lieu of investing test funds in

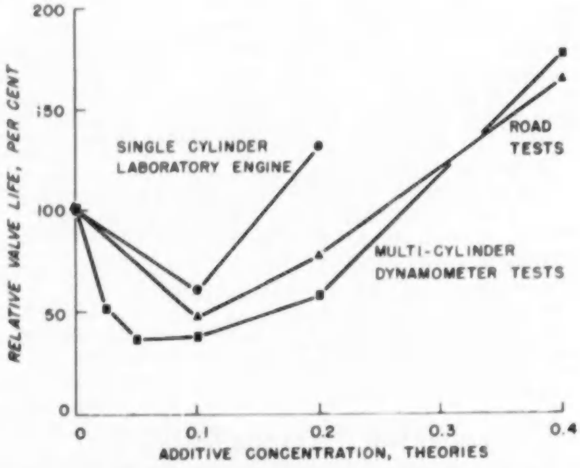


Fig. 3—Effect of fuel additive concentration on valve life with three different engines and operating conditions and two different fuel additives (Term "theory" used here to relate amount of additive to amount of lead in fuel)

these parts. A set of exhaust valves is worth about $10 new, but at the end of a test this same set of valves may represent an investment of from $1000 to $10,000. Any improvement in practicable inspection methods to ensure that alloys and structure of test parts are alike would be very much worth while. Several new preinspection tests to accomplish this objective are being tried.

The comment has been made that after changes resulting from pretest inspections, the engines are no longer representative of production units. This comment is justified, but it should be recalled that the objective is to compare durability effects of additives and not to test engines. To accomplish this, as many production variables as practicable must be eliminated.

Additive Concentration

Fig. 3 indicates the importance of additive concentration on exhaust-valve life. In order to give a very rough idea of the amount of additive involved, the lower amount shown would be about one gallon of additive for each 50,000 gal of fuel and the largest amount shown would be about one gallon for each 3000 gal of fuel. Three different engines agree generally that the two additives tested may decrease valve life if added in low concentrations and may increase valve life if added in sufficient quantity.

New versus Used Cylinder Heads

Fleet test results were mostly obtained on new cylinder heads. Some of the low-mileage cylinder heads from car make F2 were reconditioned to original pretest standards. These were operated with new valves on the same fuel and the same oil as new cylinder heads. New cylinder heads were run at the same time in other vehicles of the same make. The results of this comparison are shown in Fig. 4. The average valve life in reconditioned used heads was 35% longer than the average valve life in new cylinder heads. This is attributed to stress relieving of heads resulting from vehicle operation. It should not be assumed that reconditioned used cylinder heads will always be better than new heads, but it is obvious that data must be questioned if both new and reconditioned used heads are involved in the same test series.

Number of Tests

One of the major questions often asked is how many tests must be conducted before differences in exhaust valve life can be accepted with some assurance that the direction indicated is correct and that the magnitude of difference is somewhere near correct? In Fig. 5 we have shown the accumulated average miles to failure of two exhaust valves for one make of passenger car. Only reconditioned new cylinder heads and carefully selected exhaust valves were used for this series of tests.

These results indicate that conclusions should not be reached on the basis of a few tests. In this particular fleet at least five tests appear to be needed to indicate direction and general range of magnitude. Fewer tests may give acceptable results on the dynamometer where better control of conditions can be maintained. The similarity in trends of the center and lower lines on which the largest number of tests has been accumulated is apparently a random occurrence. The data were studied to determine whether these trends were due to seasonal variation of the weather. The study indicated that seasonal change was not responsible for similarity or differences shown. Seasonal change in some sections of the country can significantly affect test results. For this reason we believe it is important that baseline results be obtained simultaneously with results on the additive under test.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

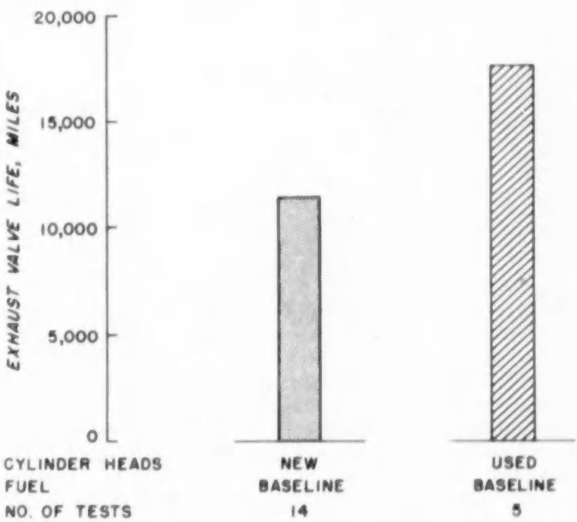


Fig. 4—Comparison of valve life with new cylinder heads and with used cylinder heads; severe-duty road tests, car make F2

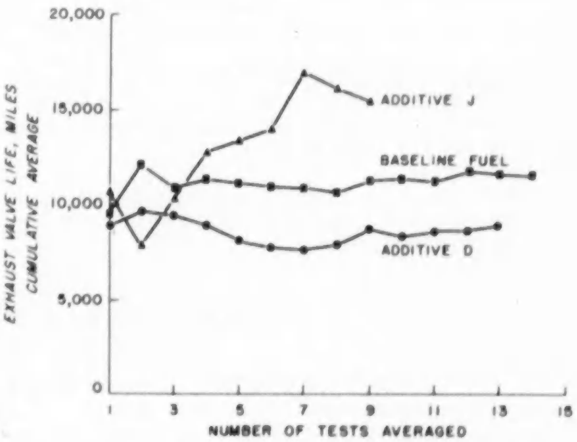


Fig. 5—Exhaust-valve life, effect of number of tests on cumulative average; severe-duty road tests, car make F2

New Attitudes and Policies

Lay Sounder

NOTHING teaches like experience. That's certainly the case for developing aircraft production sources—both prime contractors and subcontractors.

From experience in Word War II and since has emerged sensible long-range and day-to-day operating policies on the part of the Air Force and airplane builders. These policies bid fair to maintain efficient production at present rates, or to encompass a smooth, rapid buildup in case we get involved in a shooting war.

To furnish policy guidance for adjusting the aircraft industrial structure to current and projected programs, the Air Force Production Reserve Policy was effected in August of 1953. This new policy was implemented to achieve the following objectives:

1. Maintenance of industrial capacity to meet current production programs, including that necessary to provide for normal attrition losses and to keep the modern Air Force in being.

2. To procure the aircraft and related equipment produced on the most economic basis, consistent with national security.

3. To provide within the industrial structure a capacity for rapid expansion in case of a national emergency.

The Air Force feels it can achieve these objectives in the following phases:

a. Existing capacity will be maintained to the fullest extent practicable, consistent with economic considerations, design and development capacity of the supplier, and its mobilization capacity.

b. Where portions of the industrial structure cannot be supported economically by current or projected programs, but are considered essential to production reserve, the Air Force will take steps to retain this capacity in a degree of standby compatible with the mobilization urgency of the products it can produce.

c. Policies and programs dealing with industrial resources will be re-examined. Where necessary, the Air Force will make changes to provide a production reserve in keeping with its objectives.

The Air Force has set up certain criteria for retaining organizations within its production reserve structure and for selecting those for future needs. These organizations will have to have required management and technical knowledge for their specific jobs. They must have available all or at least most of the facilities and equipment to furnish required capacity. And these organizations should be sufficiently well financed so they will need only to supplement their capital. They should not expect to rely completely on government assistance.

Just as the Air Force has evolved a sound policy for maintaining its industrial plant, so airframe manufacturers have crystallized their responsibilities to subcontractors.

It used to be that a prime contractor would send his supplier a package of drawings, a purchase order, and expect him to perform. Experience has shown that this "let him go it alone" theory won't work. The only way to prevent poor subcontractor performance on delivery or costs is to take steps before trouble arises.

The kind of help airplane manufacturers can give subcontractors falls into three categories: general, technical, and mechanical.

Procurement Base

C. R. Campbell, Rohr Aircraft Corp

Based on secretary's report on panel on Procurement of the SAE Aircraft Production Forum, Los Angeles, Sept. 30, 1953.

The general assistance can take the form of help in procuring facilities—buildings, equipment, and machine tools. Survey team visits by manufacturing specialists generate helpful recommendations on operating problems. Help in materials procurement also is desirable.

It's desirable too to train the subcontractor's personnel, acquainting them with the problems they will face and how to handle them. The training can be done both at the prime contractor's plant and the supplier's plant. Manuals and documents furnished to employees can prove helpful.

Technical assistance can take the form of sending liaison engineering personnel to the sub's plant. The same thing can be done with tool planning and tool coordination personnel. Special process survey teams assist also with procedures to insure compliance with special process specifications such as spotwelding, coin dimpling, brazing, spar milling, metal bonding, and sealing.

And a good way to cut vendor inspection down from basis of 100% inspection usually needed at first is to place quality control personnel in the vendor's plant.

The vendor may need mechanical help, too, by way of specialized equipment such as coin dimplers and spot welders until he can get his own equipment.

(The full text of this report, along with that of the secretaries' reports of the nine other panels of this Production Forum, is available from SAE Special Publications Department as SP-304. Price: $2.00 to members, $4.00 to nonmembers.)

The Idea Men

The thoughts expressed in this article were provided and stimulated by the members of the Procurement Panel, who were:

- **A. R. Campbell, Leader**
  Purchasing Agent, Rohr Aircraft Corp
- **J. W. Hinchcliffe, Co-Leader**
  Chief of Materiel, Northrop Aircraft, Inc
- **C. R. Campbell, Secretary**
  Purchasing Agent, Riverside Division, Rohr Aircraft Corp
- **C. D. Collier,**
  Chief of Materiel, Temco Aircraft Corp
- **Frank Dobbins,**
  Chief of Materiel, Boeing Airplane Co
- **Howard Golem,**
  Director of Procurement, Consolidated Vultee Aircraft Corp
- **Brig.-Gen. K. D. Metzger,**
  Chief, Production and Resources Division, Air Materiel Command, Wright-Patterson Air Force Base

Second Spark Plug Aids Study of

> ***Definitions***
>
> **THE following definitions should prove helpful in understanding the material presented in this article:**
>
> ***Surface Ignition***—The initiation of a flame front by any hot surface prior to the arrival of the normal flame front. The flame front or fronts so established propagate at normal velocities.
>
> ***Simulated Surface Ignition***—For the purpose of this article, simulating of surface ignition by the use of a second, independently timed spark plug.
>
> ***Autoignition***—The spontaneous ignition and the resulting very rapid reaction of a portion or all of the fuel-air mixture. The flame speed is many, many times greater than that which follows normal spark ignition.
>
> ***Knock***—The noise associated with autoignition of the fuel-air mixture ahead of the advancing flame front. The flame front is presupposed to be moving at normal velocity. The source of the normal flame front is immaterial—it may be the result of surface ignition or spark ignition.
>
> ***Spark-knock***—A knock that is recurrent and repeatable in terms of audibility. It is controllable by the spark advance. This definition does not include knock induced by surface ignition.
>
> ***Knocking Surface Ignition***—Knock that has been preceded by surface ignition. It may or may not be recurrent and repeatable.

SURFACE ignition simulated by means of an independently timed second spark plug can either increase or decrease the power output of the engine. The magnitude and even the direction of the change are largely dependent upon the basic spark timing of the engine as well as the time at which the second ignition takes place. It can also increase the level of fuel octane quality needed to eliminate the noise that indicates the presence of knock.

The second spark plug was used to simulate surface ignition because the surface ignition induced by hot spots in an engine is often transient in nature and difficult to reproduce. This makes a systematic study of surface ignition effects on the performance of engines actually operating in service a difficult and time-consuming task. The second spark plug circumvents this difficulty nicely by providing an artificial source of ignition that is constant in both time and location. Determining the effects of ignition from such a controlled source is much simpler than with an erratic source.

Is Use of Second Plug Justified?

Superficially, the use of two spark plugs certainly does not completely duplicate what goes on when surface ignition occurs in an engine in service. However, based on information presented by Lewis and von Elbe,[1] it is probably justifiable to assume that all self-propagating flames in the same explosive medium have the same properties. That is, after a very short time (on the order of microseconds) a flame produced by a spark has the characteristics of a flame ignited by a hot spot. In order to check this conclusion, use was made of a series of photographs taken by Withrow and Bowditch,[2]

[1] See pp. 351-369 of "Combustion, Flames, and Explosion of Gases," by B. Lewis and G. von Elbe. Pub. by Academic Press, Inc., New York, 1953.

Surface Ignition

L. B. Shore and J. F. Kunc, Jr.,

Esso Laboratories—Research Division, Standard Oil Development Co.

Excerpts from paper, "Effect of Simulated Surface Ignition on Engine Performance," presented at the SAE Summer Meeting, Atlantic City, June 10, 1954.

through a quartz head, in which flames from the spark and from surface ignition were present simultaneously. By measurement of the inflamed areas in these photographs as a function of time, it was determined that the rates of flame growth were independent of the ignition source. It is true that a flame front originated by a large hot spot may have a greater surface than one originated by an electric spark and thus liberate more energy per unit time. This, however, is a difference in degree and not in kind. Such a difference could be simulated by firing more than one additional spark plug simultaneously.

Apparatus and Procedures

The engine used in these studies was an overhead-valve, variable-speed CFR engine equipped with a high-speed crankshaft. The standard CFR carburetor was replaced by an updraft carburetor with an adjustable throttle plate. The cylinder head used has four access ports. Fig. 1 is a schematic drawing of the combustion chamber showing the location of the spark plug, the added source of ignition (also a spark plug), and of the pressure indicator used. It is seen that the simulated surface ignition source is located 135 deg around the chamber from the spark plug. A second set of independently timed ignition points and an ignition coil were used to produce the second source of ignition.

During all of the work the combustion chamber was kept substantially free of deposits. This means that there were no sources of uncontrolled surface ignition present and that the octane requirement of

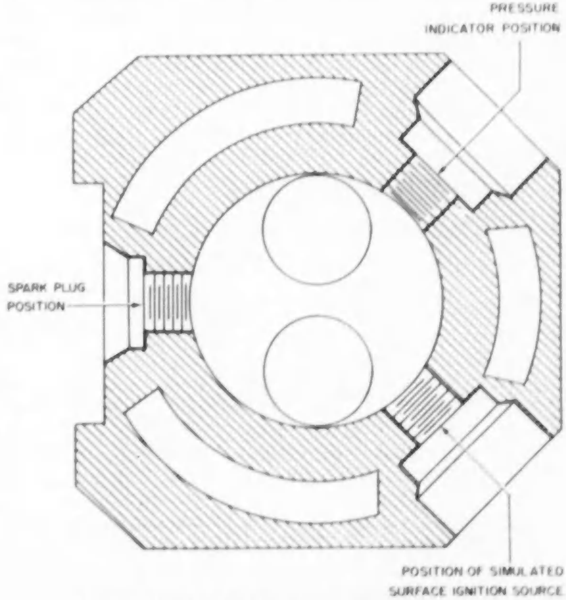


Fig. 1—Sketch of CFR engine combustion chamber

[1] See SAE **Quarterly** Transactions, Vol. 6, October, 1952, pp. 724-752: "Flame Photographs of Autoignition Induced by Combustion-Chamber Deposits," by L. L. Withrow and F. W. Bowditch.

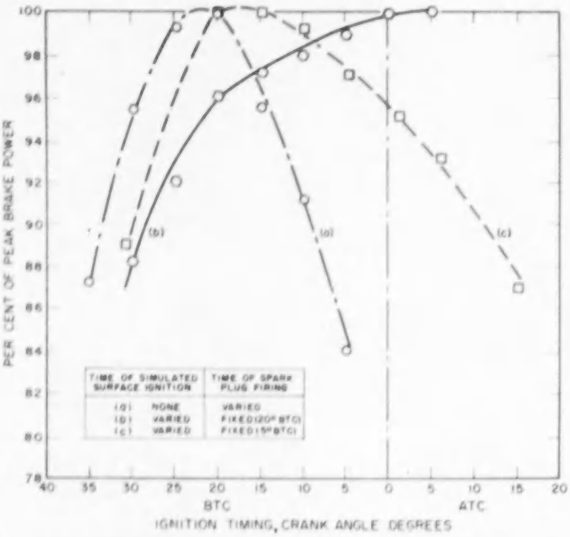


Fig. 2—Effect of simulated surface ignition on power—isooctane (constant throttle, constant intake manifold pressure, even though timing varied)

the engine did not increase during the course of the tests as the result of the formation of deposits.

Effect on Power Output

The effect of a second source of ignition on the power delivered by the engine under nonknocking conditions is illustrated in Fig. 2. Curve (a) shows the situation that prevailed when the engine was operated in the normal fashion, with ignition being induced only by the standard spark plug (no simulated surface ignition). It is seen that peak power output was attained with spark timing set at 20 deg before top center (btc). As the spark timing was retarded, the power fell off so that with the spark firing at 5 deg btc only 84% of the maximum brake power was delivered.

As shown in Curve (b), when the standard plug was firing at its peak power timing (20 deg btc) the second source of ignition either had no effect or reduced the power output. For each point shown on this curve, the standard plug was firing at 20 deg btc. However, simulated surface ignition was also occurring but at the times shown along the abscissa. This curve, then, shows what a second source of ignition will do to power output when the spark is timed for peak power development. It is seen that ignition by a second source occurring at 20 deg btc (simultaneously with the first source of ignition) caused a decrease in power to 96% of the peak value. When the second source fired about 20 deg after the standard plug, it was apparently firing into already burnt gas since it had no influence upon the power output. In general, it may be said that, with the spark timed for peak power development, surface ignition can cause a drop in the power output but this drop will be small unless it takes place well before the spark is fired.

When the timing of the standard spark is substantially retarded from peak power, surface ignition can cause a large increase in power output. This is shown in curve (c). Here the standard plug was continually firing at 5 deg btc, that is, retarded 15 deg from the peak power settings. Curve (a) shows that, at this timing, without an additional source of ignition, the power output was 84% of the peak value. Under these conditions, a second ignition occurring simultaneously with the first (5 deg btc) caused the power to increase from 84 to 97% of the maximum. Even a second ignition occurring as late as 5 deg atc could cause an increase in the power output from 84 to 92% of the peak. When the second source was firing at 17 deg btc the power was back up to the maximum possible value under these operating conditions. It appears that, for surface ignition to cause a power decrease, it would have to occur at least 30 deg before the firing of the spark.

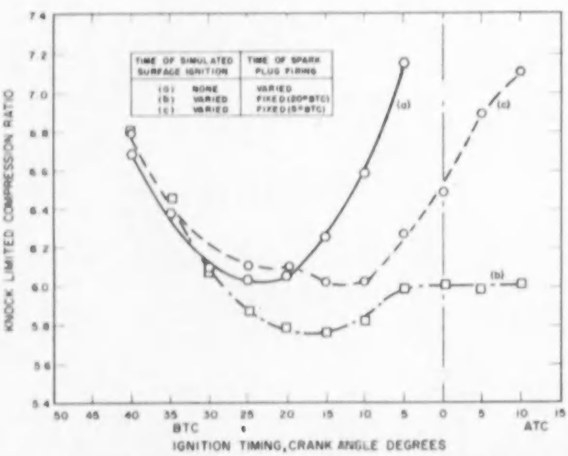


Fig. 3—Effect of simulated surface ignition on knock-limited compression ratio (primary reference fuel, 86 octane number)

Effect on Knock-Limited Performance

In some engines, under certain types of operating conditions, surface ignition is able to bring on the occurrence of occasional knocks, even when operating on a fuel of sufficiently high octane level to prevent spark knock. The surface-ignition knock differs from spark knock, in its external manifestations, mainly in its erratic and unpredictable nature. This erratic behavior is the result of the transient nature of the sources of surface ignition. There is every reason to believe that steady surface ignition would be capable of causing the steady occurrence of end-gas autoignition identical in every respect to the autoignition that occurs in a knocking engine without surface ignition. With a second spark plug, the situation that would prevail with a steady source of surface ignition is duplicated. Thus, all of the knocking observed during the course of these experiments was steady in nature. Nevertheless, the changes in octane requirement brought on by the simulated source of surface ignition in this work should correspond to changes in octane requirement caused by surface ignition in conventional engine operation.

The effect of simulated surface ignition on knock-limited compression ratio (klcr) was determined for a series of primary reference fuels. It should be kept in mind that an increase in the knocking tend-

ency and thus the octane requirement of the engine will show itself as a lowering of the klcr. As was to be expected, simulated surface ignition can substantially increase the knocking tendency or, in other words, decrease the knock-limited compression ratio when operating with a fuel of given antiknock quality. A typical set of data illustrating this is shown in Fig. 3. Curve (a) shows the effect of varying the timing of the standard spark plug with no other ignition occurring. A minimum value of 6.0/1 was observed for the klcr when the spark timing was in the region of 20 to 25 deg btc. This means that the knocking tendency and correspondingly the octane requirement were highest in this range of spark timing. As the spark was retarded, the klcr increased until, with the plug firing at 5 deg btc, a value of 7.2/1 was reached.

The effect of simulated surface ignition with the standard plug set for peak power development is shown in curve (b). These data were obtained with the spark plug firing at 20 deg btc and with simulated surface ignition taking place at the time shown along the abscissa. It is seen that, as the timing of the second ignition source was advanced from 10 deg atc, there was, first of all, no change in the value of 6.0/1 for the klcr. This merely means that the second plug was firing into already burnt gas and therefore had no influence. However, when the timing was advanced to 5 deg btc, the klcr began to drop, indicating an increase in tendency to knock. The klcr continued to drop till it reached a minimum of 5.7/1, when simulated surface ignition took place at about 17 deg btc. Further advancement of the time of the simulated surface ignition caused an increase in klcr. There was, therefore, a maximum drop of 0.3 units brought on by simulated surface ignition. By the time the second ignition source was firing at 35 deg btc the standard plug was firing into burnt gas and had no effect. It can be seen that the second plug consistently allowed a 0.1 unit greater klcr than the standard plug. This was apparently due to the differences in location of the two plugs.

Curve (c) indicates that, when the standard plug is well retarded from peak power, simulated surface ignition can have a considerably greater effect in increasing knocking tendency. In the case shown here, the standard plug was set to fire at 5 deg btc. This gave a klcr without the second source of ignition of 7.2/1. However, as the second source was brought in and advanced from 10 deg atc there was a continuous drop in klcr until, at about 10 deg btc, a minimum of 6.1/1 was reached. There was then a very gradual increase until, at 35 deg btc, curve (c) coincided with curve (b). This again indicates that the standard plug was firing into gas through which a flame front had already passed.

Families of curves similar to those shown in Fig. 3 were obtained with other primary reference fuels. All of these sets of curves closely resembled those obtained with the 86-octane-number primary fuel except, of course, that they were displaced in a vertical direction. By linear interpolation among these curves at a given compression ratio level, it is possible to convert these data into octane requirements.

[3] See p. 89 of "Combustion Engines," by M. S. Fraas. Pub. by McGraw-Hill, New York, 1948.

Table 1—Effect of Simulated Surface Ignition on Octane Requirements

	Octane Requirement	
	With Standard Plug at 20 Deg Btc	With Standard Plug at 5 Deg Btc
Ignition by Standard Plug Only	95.9	85.9
Simultaneous Ignition by Two Sources	98.9	92.5
Maximum Requirement with Two Sources of Ignition	99.0	95.3

Such a set of octane requirements is shown in Fig. 4 for a compression ratio of 7.0/1. The information as to changes in knocking tendency expressed in terms of octane requirements does not differ from that previously discussed on the basis of klcr. However, since octane requirements are more familiar units, it may prove worth while to examine these requirements briefly. Some of the pertinent data are shown in Table 1.

The octane requirement results can be summarized as follows:

1. When the spark is retarded from peak power timing, surface ignition can cause a greater increase in octane requirement than when the spark is set for peak power development. Table 1 shows that, when the spark was set for peak power (20 deg btc), the second ignition source caused an increase in the requirement from 95.9 to 99.0 octane number, or 3.1 units. On the other hand, with the spark timing retarded to 5 deg btc, an increase in requirement from 85.9 to 95.3, or 9.4 units was caused by the additional source of ignition. The increase possible with a retarded spark was thus three times greater, but the maximum octane requirement reached was lower than that noted when the engine was operated at maximum power spark setting.

2. Surface ignition need not occur prior to the spark firing in order to increase the octane requirement. For instance, Table 1 shows that, with the spark at 5 deg btc, simultaneous ignition of the charge by two sources raised the requirement from 85.9 to 92.5. In fact, even surface ignition taking place well after the firing of the spark can cause a substantial rise in requirement, as shown in Fig. 4.

Effect on Combustion-Chamber Pressure

As an aid in the interpretation of the power output and antiknock quality requirement data, measurements were made of the pressure in the combustion chamber as a function of time. Some of the results are shown in Fig. 5. For all of the curves, the spark was firing at 5 deg btc. The parameter on the curves is the time at which simulated surface ignition occurred. It is seen that, without a second source of ignition, the peak pressure was 275 psia. This peak was reached at 32 deg atc. When an additional source of ignition appeared, there was a more rapid release of energy due to the presence of the two flame fronts. This caused peak pressure to be reached sooner. Since less of the burning took place during the expansion stroke, the peak pressure was also higher. Fraas[3] states that maximum

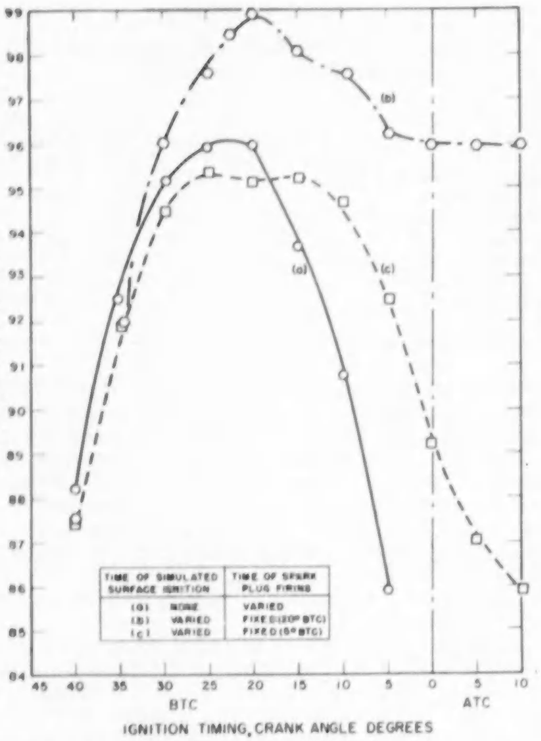


Fig. 4—Effect of simulated surface ignition on octane requirement

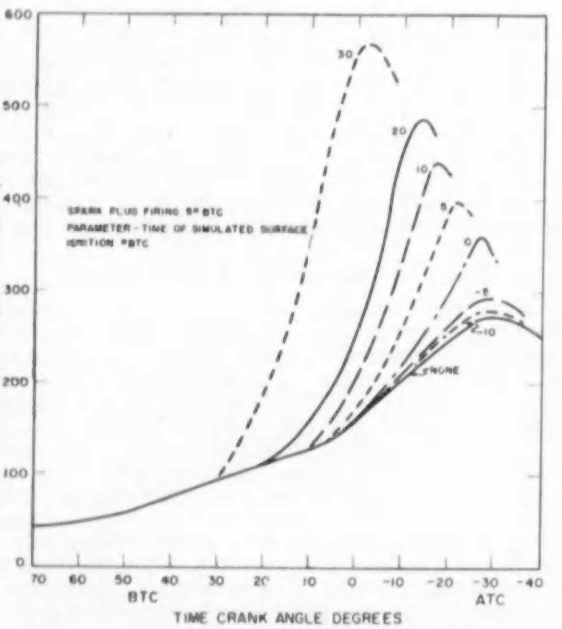


Fig. 5—Effect of simulated surface ignition on combustion-chamber pressure—isooctane (nonknocking conditions)

power output occurs when the burning takes place so that one-half of the charge burns on either side of top center. This at once explains why, with a retarded spark, simultaneous and even late surface ignition can cause an increase in the power output.

When the second ignition occurred late in the cycle, the effect on pressure rise was small because there was only a short time before the two flame fronts merged, at which time the effect of the second flame front disappeared entirely. The limiting case occurred when the second source actually fired into already burnt gas. As an example, when the charge was ignited by two sources simultaneously, the peak pressure rose from 275 to 400 psia and advanced from 32 to 23 deg atc. The effects were greater when the charge was ignited by the simulated surface ignition source before the firing of the spark; they were correspondingly smaller when a second ignition was induced after the firing of the spark. With simultaneous ignition by two sources, if the two flame fronts did not overlap, one would expect the time for combustion to be cut in half. Instead, it was cut to only about 73% of the initial value. This was sufficient, however, to lead to a 45% increase in peak pressure. The increased pressures will also bring about a substantial increase in the maximum end-gas temperatures.

The increases in the pressure and temperature stresses in the end gas have a tendency to increase the possibility of autoignition. The decrease in the time available reduces the possibility of knock. The net effect for the conditions herein discussed is that there is an increase in the knocking tendency of the end gas due to the increases in pressure and temperature.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Excerpts from Discussion

R. N. DuBois
Ford Motor Co.

It is, well known that use of double ignition, from spark plugs on opposite sides of the combustion chamber, will reduce detonation when the plugs are fired simultaneously. It is also well known that the spark advance for best power, with single ignition, is considerably greater than that required for double ignition. This is shown by the "single ignition drop" used by all aircraft pilots when testing ignition of piston engines by switching off either intake or exhaust magnetos. Both effects have been shown in the literature to be due to the reduction of distance traveled by the flame fronts when two such fronts are started from opposite sides of the combustion chamber.

In the absence of detonation, the same power can generally be obtained from single ignition as from double ignition, provided spark advance is increased to compensate for the increased distance the flame fronts must travel to complete combustion.[a]

[a] See SAE Transactions, Vol. 29, (January) 1934, pp. 17-24: "Engine-Cylinder Flame Propagation Studied by New Methods," by K. Schnauffer.

New Farm Conditions Need New Farm Machinery

Frank P. Hanson, Caterpillar Tractor Co.

Based on paper, "Tool Bars Power Controlled, Standardized Harness For Integral Equipment On Crawler Tractors," presented at SAE National Tractor Meeting, Milwaukee, September 15, 1954

THERE are many factors influencing the farmer in his current interest for tool bars and attachments on crawler tractors.

(1) **Farms are increasing in size.** The average farm was 138 acres in 1910; 215 acres in 1950. Yet available man-hours to work these farms are decreasing. Therefore, larger more versatile tractors are needed to keep up total farm output.

(2) **Farm labor is decreasing and wages increasing.** Dependable and experienced farm help is difficult to find and expensive. Total farm employment dropped from 13.6 million in 1916 to 8.6 million in 1953. Hence the farmer must turn to machinery that is easily operated by one man to take the place of hired help.

(3) **Family farms are increasing.** The average large farm is a family business. Nearly 80% of all commercial farms, producing 70% of all farm products, are owned and operated by one family. These one-man farms require greater conservation of human energy and time. Integral tractor and implements, or tool bar tractor units provide this with increased comfort and safety.

(4) **Population increase is demanding more farm production.** With the United States population increasing some 2 million each year, there is a substantial increase in food and fiber consumption. It is estimated that consumption in 1975 may be over 40% greater than the 1947–49 average. Therefore, there is need for farm machinery that will increase productivity.

(5) **Extensive farming is giving way to intensive farming.** Continued expansion of farm acreage is limited. Although some extra acreage can be obtained by reclamation, most of the necessary increased production must come from the acreage already under cultivation. Deep tillage and other new farm practices will give more production per acre, but farm machinery must be adaptable to these new techniques. (See Fig. 1)

(6) **National soil and water conservation programs are being adopted.** The farmer is gradually realizing the need for such practices. He will make greater use of dozers, scrapers, levelers, ditchers and sub-tillage tools, in addition to his usual farming equipment.

(7) **Packed or tight soils restrict plant growth.** Although there is still much research to be done, it appears that compacted soils decrease crop growth considerably. As a result, more and more farmers are interested in machines that have low ground pressures and allow the minimum number of machine trips per unit of area.

Fig. 1—Subsoiling in the western states has been practiced for years. Within the past three years many eastern state farmers have begun to use the subsoiler. This shows a single standard subsoiler on a tool bar.

Fig. 2—Bulldozers are being used in increasing numbers on farms. This tool bar bulldozer will economically handle a wide variety of jobs on the average farm.

(8) **Farming is an around-the-clock operation nowadays.** At harvest time and during special weather conditions it is sometimes necessary to work long hours. Machinery must have the reserve power and stamina to take these loads without breaking down.

(9) **Economic conditions require efficient farm management.** Agriculture is currently in a cost price squeeze. Now more than ever before, a farm must be managed well to make a profit. Machinery must be bought on a basis of cost of a unit of work done, and not on first cost alone. Equipment that can be used for many different jobs, such as land clearing, irrigation, and earthmoving, as well as farming will soon pay for itself by increasing farm output. (See Fig. 2)

In summary, the above changing conditions on the farm require larger, more versatile machinery. Equipment must be inexpensive, easily handled by one man, and able to stand up under various rough operating conditions.

The Tool Bar was designed to satisfy these requirements. Since the average farmer cannot afford to own several pieces of machinery—each for a specific job—the Tool Bar attachment allows one tractor to do the work of many.

The Tool Bar has three basic components: control, trunnion assembly, and tool bar attachments. We will take up each separately.

Control

Controlling the farm implement has undergone radical changes in the past 35 years. The trend has been to drop belt pulleys, power take-offs and drawbars in favor of auxiliary power transmitting devices. Hydraulic control was selected as the principle means of powering the tool bar for the following reasons:

(1) It is flexible and can furnish variable power needs at various places on and around the tractor.

(2) It meets speed and capacity requirements for a tractor.

(3) It can be used without interfering with a belt pulley, power take-off, or drawbar.

(4) It can be positioned to increase tractor stability.

(5) It doesn't interfere with visibility.

(6) It doesn't increase the size or weight of tractors appreciably.

(7) It can provide wide directional flexibility, permit fractional and continuous movements and include raise, lower, hold, and float positions.

Trunnions, Frame and Beam Assembly

The trunnion, frame and beam assembly was designed to give maximum operator comfort consistant with economic and functional requirements.

(1) The trunnions are placed low on the outside of the track roller frames in order to use full engine power, particularly during pushing. This also gives a crawler tractor maximum traction and distributes ground pressure evenly through the full length of the tracks.

(2) The center of lifting force is held as close as possible to the track centers. This improves lifting capacity without resorting to counter balances. Front and rear lifting is needed to raise ground engaging tools, cranes and loaders.

(3) Down pressure, both front and rear is normally less than the lifting forces. Therefore, no serious design problems are involved if double-acting hydraulic cylinders are used.

(4) Standard tool attachments will not interfere with a belt pulley or power take-off drives or a drawbar. This is because the beam was designed to lift ground engaging tools high enough to clear the seat and radiator guard during transporting.

(5) Tool bar tractor units need only one man to change tools. He can do this quickly and with a minimum lifting. Figs. 3, 4, and 5 show how a tool bar can be shifted from rear to front quickly. The draft frames or hydraulic cylinders at the trunnions need not be disconnected. The hydraulic cylinders carry the weight of the frames.

(6) No part of the tool bar interferes with operator visibility.

(7) There are only minor changes that affect starting, servicing and operating the unit as compared to the bare tractor.

(8) As compared to the bare tractor, the tool bar assembly does not change the top or bottom clearances. Only minor changes are made in side, front, and rear clearances.

Tool Bar Attachments

The modern farmer uses his crawler tractor as a bull-dozer, snowplow, and loader as well as for agricultural purposes. A list of some of the individual tools will give an idea of the variety of uses for a tractor with a tool bar.

Augurs—post hole
Bulldozers—straight and angling blades
Carriers—platform, box, and finger
Chisels
Corn pickers
Cranes
Cultivators—points, shovels, and sweeps and rod weeder
Cutters, brush—front and rear
Disc ridgers
Discs
Ditchers
Fertilizer distributors—dry and liquid-surface and underground
Furrowers
Insecticide, fungicide, and weed control dusters and sprayers
Land graders and levelers
Loaders
Middle breakers
Planters—lister, drill, hilldrop, and broadcast
Plows—disc and moldboard
Rakes—brush and rock
Snow plows
Subsoilers

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Based on Discussion

W. H. Nordenson,

John Deere Waterloo Tractor Works

The problem of stability for crawler tractors is a difficult one. They can pull larger tools than they can carry, due to side and fore and aft tilt. Chisels are easy to carry. Discs and similar wide spread tools are not so easily carried on crawlers.

Depth control is much more complicated with crawler tractors than with wheel types. Also there is a need for some type of inside carrier that will not increase overall tractor width.

E. W. Tanguary,

International Harvester Company

Here are some more facts which show the need for more equipment: It takes 2.4 acres of ground to provide food and fibre for one adult. By 1970 the U. S. will need 24 million acres more, to absorb the anticipated population increase, or else more production per acre.

One source of acreage will come from a reduction of horse population. 40 million acres have been shifted from growing food for animals to growing food for people.

Reclamation could provide 7 million acres, but this is a very costly operation.

There is much land still being converted from agricultural use to other uses such as roads, defense projects, and parks.

It will be necessary to continue mechanization and scientific farming if we are to continue to feed and clothe the increasing population.

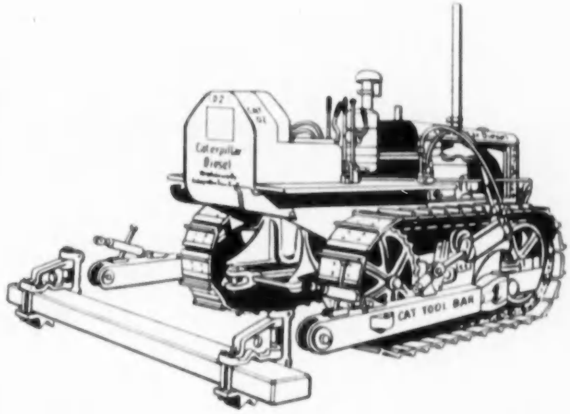


Fig. 3—The heavy duty rear mounted tool bar beam is easily and quickly removed when it is desired to use front mounted tool bar attachments.

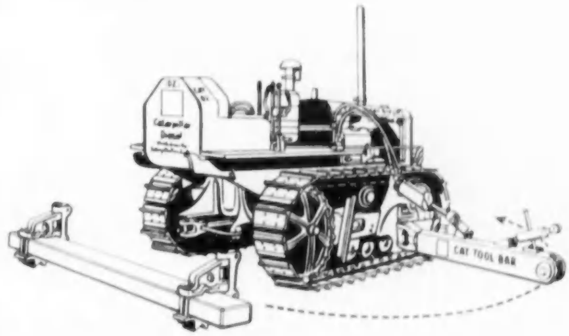


Fig. 4—Swinging the tool bar frames and hydraulic cylinders from rear to front or reverse, is easily done because they are hinged at the trunnions.

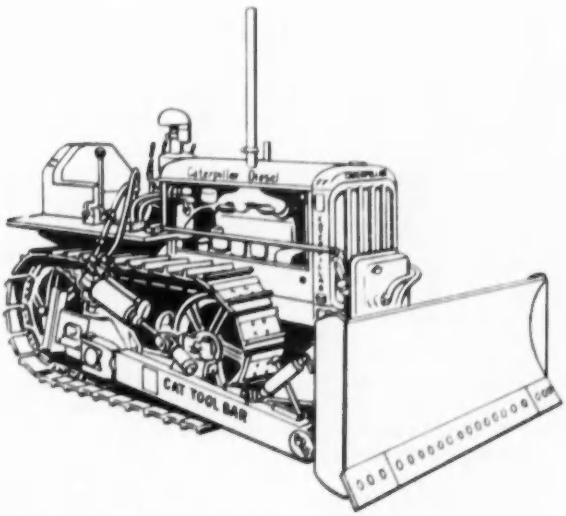
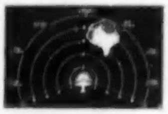


Fig. 5—The bulldozer blade is one of several front mounted tool bar attachments.

Airborne Radar Helps

As United and Braniff relate in separate reports beginning below, radar—whether C-band or X-band—reveals distant thunderstorms and hail. By observing and detouring these turbulent areas, pilots can give passengers safer, smoother, more



H. O. Harrison, Assistant Director of Communications, Braniff International Airways

Based on paper "A Summary of Braniff International Airways' AN/APS-42 Airborne Radar Evaluation Project" presented at SAE National Aeronautic Meeting, Los Angeles, Oct. 7, 1954.

FROM our first five months of evaluating AN/APS-42 radar installed in a DC-6 making normal scheduled Latin American flights, we've found that:

- Radar enables pilots to detect and avoid bad weather. They report instances in which radar made it possible for them to circumnavigate serious thunderstorm activity or to pick a path between storm cells. Without the radar, they could not have completed the flights.

- Radar simplifies navigation by piercing overcast and darkness to show coastlines, mountains, and other easily recognized landmarks. Even over plains, pilots can pick up and identify cities, towns, rivers, and lakes. But the pilot must have an idea of where he is, of course, before he can identify these targets positively. He must take care, too, to discern mountain peaks from clouds.

- Pilots are more enthusiastic about radar than about any other piece of equipment we've added to our planes. Once they try radar, they're sold on its weather-detection and terrain-mapping abilities.

- Maintenance of the AN/APS-42 radar has not been troublesome. We have replaced one rectifier. The few other tubes we have replaced have been common varieties available from local radio supply houses.

- Nothing we have seen indicates that X-band (3.2-cm-wavelength) radar is less useful for weather mapping, as some claim, than radar of other wavelengths.

The AN/APS-42 radar equipment was made available to Braniff Airways through a contract with the Bureau of Aeronautics of the Navy Department. The contract calls for flight evaluation of the radar on Braniff's Latin American routes, which extend from Houston, Texas and Miami, Florida to Brazil and Argentina via Cuba, Panama, Ecuador, Peru, Bolivia, and Paraguay.

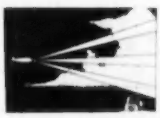
The routes flown afford various excellent opportunities to use the radar. Hardly a trip can be made from Dallas to Rio and return without encountering thunderstorm activity or frontal conditions somewhere along the route. The so-called "equatorial front" which oscillates back and forth off the coast of Colombia and Ecuador can always be counted on for some rough going. Islands in the Caribbean afford excellent radar targets for determination of aircraft position and speed checks. The route from Lima to Rio crosses some of the most rugged mountain terrain in the western hemisphere, as well as hundreds of miles of dense jungle in Bolivia and Brazil.

Since the same aircraft are operated over Braniff's

Continued on page 70

Pilots to Spot Storms

dependable flights. That fact—plus radar's ability to map overcast-obscured terrain—is the reason why commercial airlines are looking forward eagerly to the day when light-weight airborne weather radar makes its debut on the market.



E. A. Post, Supt. of Navigational Aids, United Air Lines

Based on paper "The Application of Airborne Radar to Airline Operations" presented at SAE National Aeronautic Meeting, Los Angeles, Oct. 7, 1954.

HERE's what we feel a pilot can do with radar that he can't do without it:

1. He can detour a storm area after having scanned it from over 75 miles away or more, thus giving him the opportunity to instigate a detour at a point where his flight time will be increased very little.

2. He can choose a corridor of the mildest activity or turbulence if penetration of a storm area is desirable or necessary. Normally a suitable corridor can be found without departing more than 5 miles from the planned flight path.

3. He can scan the area around an airport, before taking off or landing, to determine the best possible flight path out of or into that airport.

4. He can establish his position relative to high terrain or easily distinguishable ground features.

5. He can give valuable information to other aircraft not equipped with radar, thus reducing operational delays during storm seasons.

The ability of airborne radar to do these five things and in so doing avoid damaging hail and provide the passenger with a relatively smooth ride through thunderstorm conditions, justifies the installation of airborne radar in airline aircraft, particularly when we consider the amount of thunderstorm activity confronted every year.

Unlike previous thunderstorm probing research by American Airlines and the Navy, where pilots went out of their way to find trouble by flying through the cores of thunderstorms, United's radar-equipped Sir Echo and his crew started out in June 1953 to prove that thunderstorm conditions could be flown without getting into trouble—"trouble" in this case meaning heavy turbulence, damaging hail, and tornadoes. We knew from previous experience and research that the hard cores of thunderstorms were to be avoided and from work done by American Airlines that heavy turbulence is usually associated with areas of most rapid change in precipitation rate.

Operations were conducted out of Denver. Flights were usually planned with the goal of having the aircraft arrive in the expected thunderstorm area as the storms were developing.

The flight evaluation team included the captain, the first officer, weather observer, and flight evaluation coordinator. The cockpit scope permitted the first three crew members to make rapid and continuous comparisons of visual cloud appearances with the radar scope presentations. Notes on these comparisons were logged by the weather observer, who also kept a detailed weather log and took Polaroid and 16mm colored moving pictures of cloud exteriors. The flight evaluation coordinator, in addition to operating the radar, took radar pictures and

maintained a detailed log of the settings of the radar controls.

In four months 40 technical and operational flights were made totaling 133 hours of flying, 80 of which were in the immediate vicinity of or through corridors of thunderstorms. More than 6000 radar scope photographs were taken, and over 2500 representative radar and cloud pictures were catalogued in two large albums.

Denver turned out to be the most desirable base of operations that could have been selected. During the evaluation an abundance of thunderstorms was

United's Experimental Installation of C-Band Radar in A DC-3

Fig. A1—United's radar-equipped DC-3 Cargoliner, "Sir Echo," sports a special radome nose installed by Douglas Aircraft for evaluation flights United undertook in June-September 1953

Fig. A2—The transmitter-receiver unit, synchronizer, and NACA velocity-acceleration-altitude (VGH) recorders fit in the left baggage pit

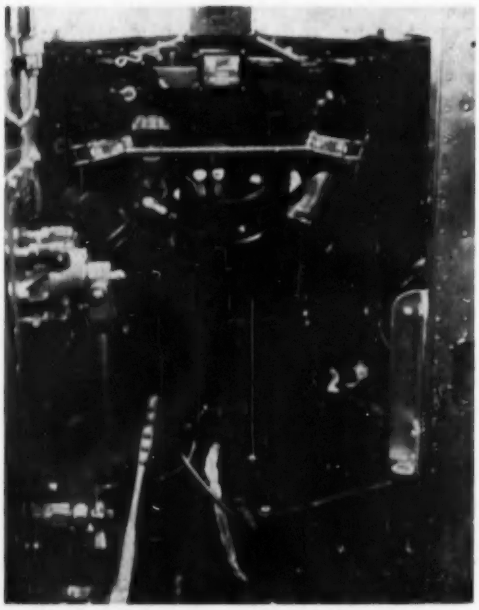


Fig. A3—A radar scope equipped with a three-eyepiece viewer was installed in the cockpit between the pilot and copilot seats

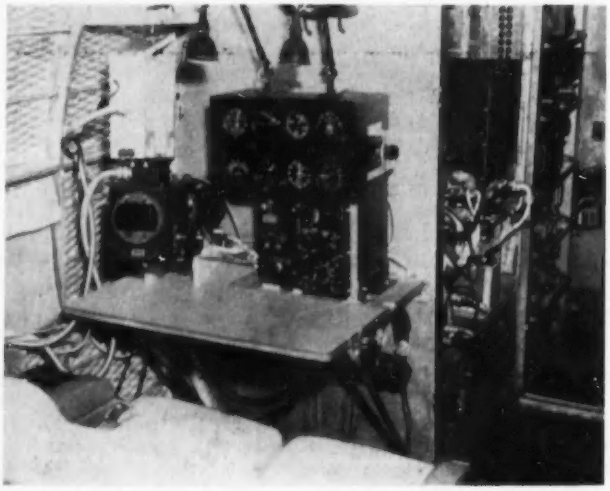


Fig. A4—The radar operator's seat is in the left forward corner of the cabin. Radar camera and periscope permit simultaneous viewing and picture taking. Operator has flight instruments as well as radar controls

Pictures of C-Band Radar Displays

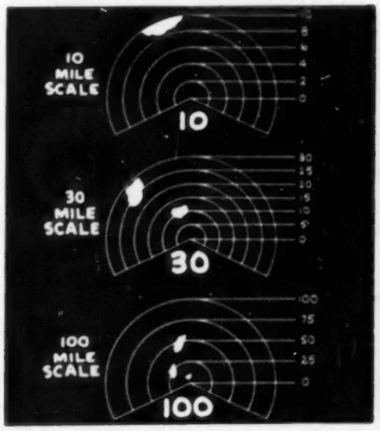
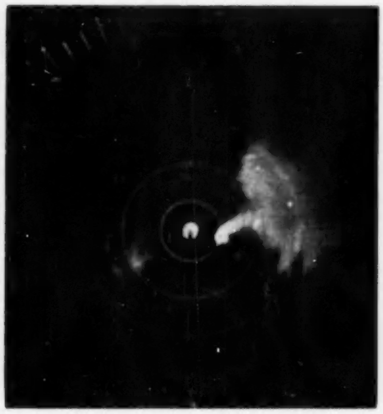
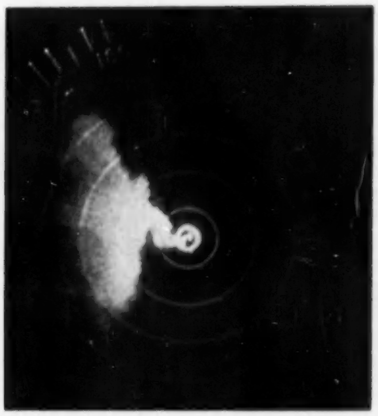


Fig. A5—United's RCA (Radio Corporation of America) experimental weather radar had three ranges: 10-mile range with 2-mile range marks, 30-mile range with 5-mile range marks, and 100-mile range with 25-mile range marks





Figs. A6 and A7—Out of United's catalog of hundreds of hail pictures, they selected 84 to study in detail as representative examples. These are two of them. Out of the 84 pictures taken of hail conditions, a hook or a finger was present in 82 of them. A finger showed in 67, a hook in 57, scalloped edges in 32, and a prominent U-shape in 25. The 84 pictures resulted from 23 flights on which hail was encountered, seen, or reported to appear on the ground

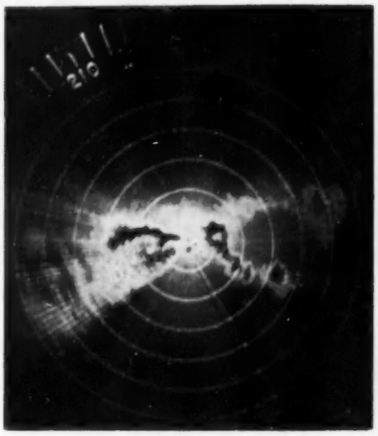


Fig. A8—Penetration capabilities are demonstrated by this clear display of two 15-mile lines of heavy rain during a cloudburst near Denver, Colorado

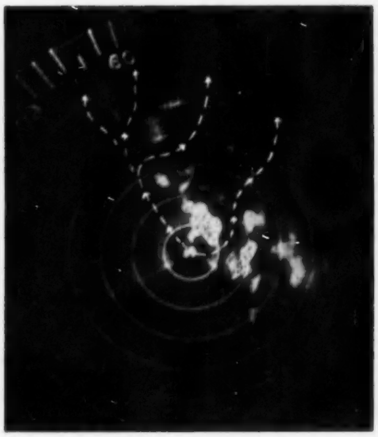


Fig. A9—Storm displays such as this enable the pilot to choose a corridor of clear air or mild turbulence if penetration of a storm area is desirable or necessary

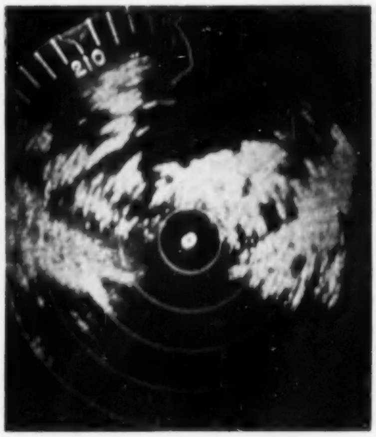


Fig. A10—Terrain mapping capability of the radar is good, as this picture shows. It's possible to tell terrain echoes from storm echoes without circular polarization

available within less than 90 minutes flying time which permitted a sampling of all types of thunderstorms except the hurricane and true nocturnal variety.

The United evaluation team was interested in comparing our 5.5-cm radar with other radars operating on shorter and longer wavelengths. We were fortunate in being able to make three comparisons; the first with a Weather Bureau 10-cm ground radar, the second with an airborne APS-42 3.2-cm radar, and the third with an Air Defense Command radar. Since only a single flight was conducted with each type, comparisons were not conclusive, but each turned up information of interest.

At North Platte, one member of the group stayed on the ground to watch the Weather Bureau 10-cm scope, while Sir Echo flew overhead, around and through the thunderstorms in the area. The radar echoes seen by Sir Echo were closely confirmed by the Weather Bureau.

During comparison with the Air Defense Radar, two members of the evaluation team stayed on the ground to view the Air Defense scope and sketch echoes while Sir Echo flew overhead. The echoes on the two scopes are nearly identical, although United actually painted more detail than Air Defense. This was to be expected, of course, because United's was closer to the precipitation. No opportunity was afforded to study the Air Defense scope displays of distant precipitation echoes.

Observations of weather echoes on the ground radar scopes lead us to conclude that while these

radars would show severe storms at distances of 100 miles or more, the resolution with their larger antennas is not sufficient to permit ground operators to vector aircraft through narrow corridors between storms when the storms are more than 40 or 50 miles distant. Air Defense controllers confirmed this thinking by informing us that their vectoring service consisted of steering pilots around storms and storm lines and not through them.

Our third comparison was with an APS-42 3.2-cm radar installed in a Navy R5D. The most amazing thing about this comparison flight was the weather itself. Unscheduled and unpremeditated, this follow-the-leader flight was set up on the morning of August 9, when there wasn't a cloud in the sky within 300 miles of Denver. That afternoon within an hour's flying of Denver, an 8-in. cloudburst occurred between Flagler and Burlington which put the Rock Island Railroad tracks under water, washed out highway bridges, and inundated whole ranching communities. Hail fell in several spots. One of the pictures taken aboard Sir Echo that afternoon showed a north-south line of storms 140 miles long. This was the longest line of storms brought within view of our scope during the whole summer season.

Paired 3.2-cm and 5.5-cm pictures showed overpainting by the 3.2-cm radar. We observed cases where the 3.2-cm showed a strong echo while the 5.5-cm painted in only harmless fuzzy which we had found from experience could be flown through with no difficulty. In other cases 3.2-cm radar echoes were attenuated and detail lost in the back of the echo.

Our experience indicates that if you do not want to be misled by airborne radar weather indications, you had better use a wavelength of 5.5 cm rather than 3.2 cm. Of course, if you plan to avoid all storms by flying around them, 3.2 cm will help you do that.

Illumination of existing type cathode ray tubes is adequate for operation in the cockpit without a hood only during night conditions. During daylight operations a hood is required in order to permit the observer's eyes to become adjusted to the low light intensities presented on the scope. In view of this fact and until the bright storage display tube becomes available, the scope should be located beside the pilot's seat so that it may be used with a hood and viewed with the pilot's eyes not more than 18 to 20 in. from the scope face. One bright storage type display located in the center of the instrument panel will probably be adequate for both pilot and copilot. Until the bright display becomes available, we plan separate scopes for pilot and copilot.

It is my belief that the characteristics of the present-type scope tube call for almost continuous pilot attention while flying through thunderstorm corridors. A bright storage tube should reduce the attention required. It is the general feeling of those who participated in the United evaluation program that when actually engaged in the process of penetrating a line of storms, particularly through narrow corridors, one crew member should devote most or all of his time to observing the scope, directing the other crew member where to fly. If an autopilot is being used, the pilot doing the radar observing can also fly the airplane.

Since most storm lines are not very wide when penetrated perpendicularly, the period of time during which one crew member would be devoting most of his time to the radar would be limited. Therefore, we do not envision any need for a third crew member to maintain the radar watch.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price 35¢ to members, 60¢ to nonmembers.)

Braniff Tries 3.2-Cm Weather Radar

continued from page 66

domestic routes between Dallas, Houston, San Antonio, and Chicago, we have also had an opportunity to evaluate the use of the radar over the type of terrain encountered on these routes.

The AN/APS-42 radar is a general-purpose, 3.2-cm-wavelength airborne radar intended primarily for use in military transport-type aircraft. It develops a peak power output of 40–50 kw and has a maximum range of 200 nautical miles. Diameter of the antenna is 18 in., which provides a beam width of about 5 deg. Beam pattern may be changed at will from a pencil beam to a cosecant-squared beam. The pencil beam, or "obstacle beam," is used primarily for weather detection and terrain clearance. The cosecant-squared, or "mapping beam," is employed for terrain mapping and navigational purposes. Figs. B1–B5 show the installation.

For approximately six weeks after the installation of the radar was completed, the radar was actually used only when a technician was on board to operate it. During this period several hundred pictures of the radar display were obtained, illustrating various weather conditions observed and operation of the radar for terrain mapping and navigational purposes. Figs. B6–B10 show some of the photographs.

Before the radar was turned over to the pilots for operation, each pilot who would have an opportunity to fly the radar-equipped aircraft received approxi-

mately two hours of classroom instruction in the basic principles of operation and in interpreting the display.

There were a few occasions shortly after the radar was placed in operation when the pilot had to see for himself whether the radar was painting a true picture. . . . To a man, they were convinced that it was!

Penetration of a finger extending from the side of a cloud on the first trip after installation of the radar resulted in encountering a slight amount of hail. No damage to the airplane was sustained, but there was a slight amount of damage to the radome in the form of erosion of the laminated fiberglass and two or three small soft spots. This damage was so slight that it was not detected until the ship returned to Dallas.

A neoprene boot 1/32-in. thick by approximately 18 in. in diameter was cemented to the radome. It appears to be very effective in preventing further erosion of the radome, with no noticeable effect on performance of the radar.

As of September 1, the aircraft in which the radar is installed had accumulated a total of 1166 hours since the installation was made. The radar has actually been turned on and operating for approximately 290 hours during this time.

The AN/APS-42 radar is more complex than we would like to see for commercial airline use. Yet no serious difficulty was experienced in installing the radar or in making it work. What trouble we have had with the installation was due to faulty pressurization of the receiver-transmitter unit. In the original installation, a hand pump similar to an automobile tire pump, was provided for pressurizing the receiver-transmitter unit and the waveguide to the antenna. Not only did it take considerable time to pump up the required pressure within these units, but we found later that we had so much leakage that the pressure dissipated in a comparatively short

Braniff's Experimental Installation of X-Band Radar in a DC-6

Fig. B1—Reworked DC-6 becomes a radome housing the radar antenna. Receiver-transmitter unit nestles in the upper right-hand portion of the nose wheel well. About 30 in. of wave guide connects the receiver-transmitter to the antenna

Fig. B2—The synchronizer is located on the flight deck, on a shelf below the level of the radio operator's table

Fig. B3—A camera photographs this radar observer's indicator. Boxes at right contain radar controls and iso-echo circuitry

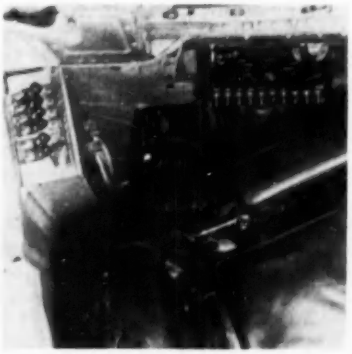


Fig. B4—When pilot is to operate the radar, the control panel is moved to a location just outboard of the pilot's seat

Fig. B5—Pilot's radar indicator is located just outboard of and above the left rudder pedals as shown here

Photographs of X-Band Radar Displays

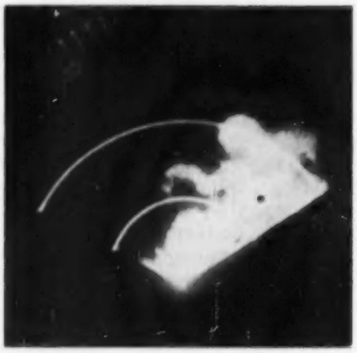


Fig. B6—First trip with radar produced this finger characteristic of hail. Penetration of the finger proved the hail was there

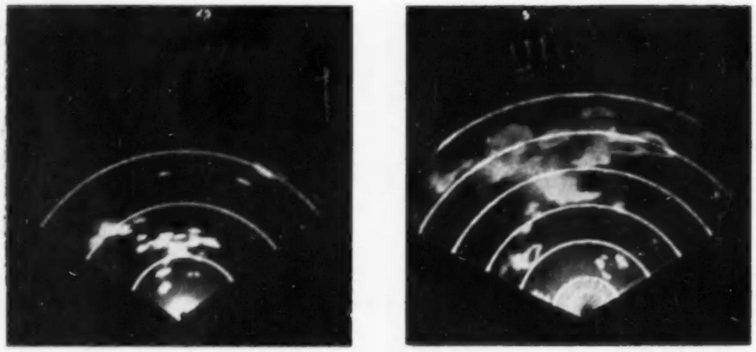
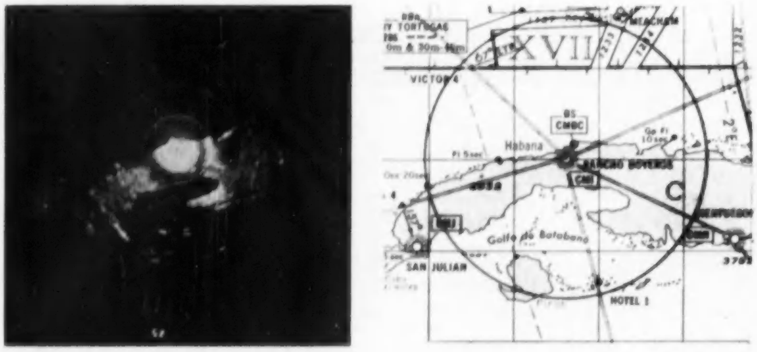


Fig. B7 and B8—Use of iso-echo contour circuitry to indicate the hard cores of thunder storm cells adds greatly to radar's usefulness. Display with iso-echo off appears at left. Right view shows display with iso-echo on (and at a magnified scale). With iso-echo on, areas of heavy rain show as dark holes



Figs. B9 and B10—Radar picture conforms closely to map, showing radar's usefulness in determining position. (Radar photograph was actually made on a southward flight and is shown upside down here to agree with map)

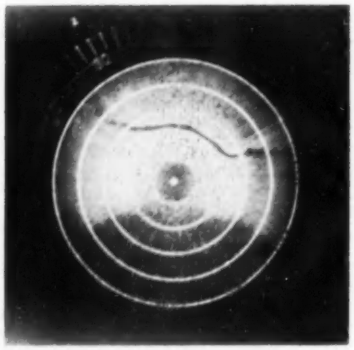


Fig. B11—This is how Rio Parana in Brazil looks on the radar scope to Braniff pilots as they approach it

time. We checked over the waveguide system thoroughly to reduce pressure leakage to a minimum and installed an automatic pressurization pump. Since that time our troubles with the radar have been insignificant.

We at Braniff are enthusiastic about the possibilities of airborne radar for commercial airline use. We feel that eventually all four-engine aircraft, and possibly many two-engine aircraft, in use by the commercial airlines will be equipped with radar. Whether it be X-band or C-band, operators and passengers will benefit.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Discussion—M. G. Beard, American Airlines, Inc.

The evaluation of airborne radar we carried out under military contract and completed in 1948 left us with the same enthusiasm for it as United and Braniff show.

AAL experience on the Alaskan cargo route was highly successful. Flight personnel were keenly aware of the advantages of radar-equipped airplanes. We feel that radar offers improved schedule reliability as well as smoother ride.

C-band radar, such as UAL used, shows rainfall gradient with greater integrity than X-band radar does. But beacon reception, good PPI (plan position indicator) mapping, and freedom from icing troubles might favor X-band radar.

We hope that aircraft manufacturers will study the use of radar carefully. We feel that it might help alleviate fatigue problems and thereby give transport aircraft longer life.

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SAE Journal sooner or later prints an abridgment of every paper presented at SAE National and Section Meetings. So, every paper is mentioned at some time in the INDEX.

Every paper is indexed by:

1. ***Original title.***
2. ***Journal headline.***
3. ***Authors' names.***
4. ***Subject headings.***

When the **Journal** article contains discussion, the names of the discussers are also listed.

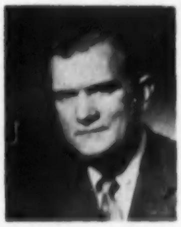
The 1954 INDEX covers all material published in the **Journal** during 1954, based on the following:

1. ***Papers presented at National Meetings.***
2. ***Papers presented at Section Meetings, received at SAE Headquarters.***
3. ***Round table and production panel reports received at SAE Headquarters.***

About SAE

GEORGE H. FREYERMUTH has been elected executive vice president and director of Esso Export Corp. He had been manager of public relations with Standard Oil Co. (New Jersey).

Esso Export is the international sales affiliate of Standard Oil (New Jersey), which Freyermuth joined 26 years ago as chemical engineer.



Freyermuth

Chapman

B. A. CHAPMAN has been appointed vice-president and general manager of the Kelvinator Division, American Motors Corp., producer of American Motors Corp.'s Kelvinator and Leonard brands of home appliances, and Kelvinator commercial refrigeration equipment. He was production manager for Nash-Kelvinator Corp.

GEORGE PAUL has joined Boeing Airplane Co. in Seattle as associate research engineer. He had been design engineer with Buda Co. of Harvey, Ill.

ROGER M. KYES was guest speaker before the Association of National Advertisers, Inc. at Hotel Plaza, Nov. 10. Kyes, vice president of General Motors Corp., entitled his talk, "Freedom is a Dynamic Action." In conclusion he made the following statement:

"If we replace the philosophies of negligence and inaction with the philosophies of responsibility and action, we need have no concern for the future of America spiritually, economically, socially, or militarily. The more pure water we pour into the river of life from the springs of freedom the less will be the opportunity for false philosophies to produce contamination.

The building of a stronger society of men and women in America is our responsibility and our salvation—let's go home and do something about it."

HERBERT S. JANDUS, previously patent engineer with Houdaille-Hershey Corp., Highland Park, Mich., has retired and is residing at 2434 Ferncliff, Royal Oak, Mich.

HOWARD R. COOK, previously supervisor of the Technical Department of the Cleveland Diesel Engine Division, General Motors Corp., is now assistant chief engineer, Diesel, Advanced Engineering, with International Harvester Co., Melrose Park, Ill.

DR. ANDREW KUCHER, director of the Scientific Laboratory, Ford Motor Co., presented a discussion of gas turbines and the possibility of their adaptation to farm tractors at the Oct. 23 Michigan Section meeting of the American Society of Agricultural Engineers. Dr. Kucher pointed out that the turbine engine can not compete with the internal combustion engines of today.

DR. LOUIS L. OTTO also gave a discussion at this meeting. He traced the development of the Diesel and spark ignition internal combustion engines. One major advantage of the turbine would possibly be the reduction of gears required—often as many as 15 in a truck.

WAYNE HOWARD, previously vice president of engineering with Torcon Corp. of Ashtabula, Ohio, is product engineer with Clark Equipment Co. of Jackson, Mich.

LAWRENCE A. HYLAND has been appointed vice president and general manager of Hughes Aircraft Co. To accept his new post, Hyland resigned as vice president in charge of engineering of Bendix Aviation Corp. He had been with Bendix since 1937.

FRED WEHMER is now associated with Minnesota Mining & Mfg. Co., Detroit, as manager of Commercial Development Department. Formerly he served with Rubber and Asbestos Corp., Bloomfield, N. J., as technical sales manager.

RUSH SIMONSON, previously automotive service engineer, is now Southern zone manager, National Accounts, Automotive Products Sales, National Carbon Co.

RICHARD M. CORS has joined the Oliver Corp., Outboard Motor Division, Battle Creek, Mich., as sales manager. He had formerly served as vice president of Champion Motors Co., Minneapolis, Minn.

K. B. HOPFINGER, consulting engineer located at Hamton-in-Arden, Birmingham, England, has published the story of the Volkswagen in his book entitled, "Beyond Expectation." He presents the story of the development of the Volkswagen by Dr. Ferdinand Porsche under the control of Adolph Hitler. Under Hitler's instructions, Porsche designed a military version of the Volkswagen which was favored by Rommel in his thrust through France and North Africa.

Hopfinger

Wilson

HARLAND D. WILSON has been appointed administrative assistant to the vice president in charge of engineering, in The Electric Auto-Lite Co.'s Central Engineering Division. He formerly served as chief chemical engineer. Wilson is Chairman of the SAE Storage Battery Subcommittee. Two other SAE members were appointed to new positions. **LOCKE P. ATWELL,** formerly sales engineer, is now assistant to the chief ignition engineer. **JAMES F. ELWELL** has become senior spark plug engineer. He was design engineer—spark plugs.

Members

Bohrman

Panthofer

DON WING has taken the position of associate project engineer with Schlumberger Well Surveying Corp., Houston, Texas. He had been associated with Available Truck Co. in Chicago, as chief engineer.

ROBERT G. THOM, who was mechanical engineer in the U. S. Army at Rocky Mountain Arsenal, Denver, Colo., is now a layout draftsman with Massey-Harris-Ferguson, Inc. in Detroit.

Cornell University has announced the appointment of **Dr. T. P. WRIGHT** as professor of Air Transportation in the School of Business and Public Administration. Dr. Wright, vice president for research at the university, is president of the Cornell Aeronautical Laboratory in Buffalo and former head of the Civil Aeronautics Administration.

Wright

Fuller

E. W. FULLER, who was director, Staff Engineering with American Airlines, Inc. in New York, has joined REF Mfg. Corp., Poly-Plastics Division, as manager of the division. This division has been newly established for the purpose of placing the Corporation, which is now a quality sheet metal fabricator, into the reinforced plastics field.

W. A. ROBERTS, president of Allis-Chalmers Mfg. Co., and **EDWIN B. MEISSNER,** president and general manager of the St. Louis Car Co., have been named for three year terms as trustees of the National Security Industrial Association. Founded 10 years ago by the late James Forrestal, the NSIA serves as a link between American industry and the military establishment.

GUSTAV G. C. SCHARFF is now on the Engineering Staff, Power Development Group, General Motors Technical Center, Detroit. He had formerly been assistant engine engineer with General Motors Holden's Ltd., Melbourne, Australia.

MURRAY FAHNESTOCK devoted a 2-page article to the "Automotive Industry's Debt to the SAE" in Ford Field magazine, for which he has been editor and writer for more than 40 years. He told how friendly cooperation between SAE members has been an important factor in the revolution-on-wheels that had done so much to change the world.

HOWARD W. SONDERMAN has joined Franklin Electric Co., Bluffton, Ind. as an engineer. He was an engineer with the Snow, Ice and Permafrost Research Establishment of Wilmette, Ill.

JERVIS C. WEBB, president and general manager of Jervis B. Webb Co., Detroit, Mich., was elected president of the Conveyor Equipment Manufacturing Association at its 21st annual meeting. He will serve as chairman of a policy committee to deal with long-range planning for the association.

IRVING G. BOHRMAN has been elected president of the Perfex Corp., Milwaukee, Wis. He had been vice president and general manager of the Radiator Division of Perfex, which manufactures industrial cooling radiators and heat transfer products as well as automatic controls for heating, ventilating, and air conditioning. **ERNEST H. PANTHOFER** has been elected vice president to succeed Bohrman. Panthofer had served as assistant general manager with Perfex. He is currently Treasurer of SAE Milwaukee Section and has served on the Section's Governing Board for the last five years.

CHARLES A. RUHL has joined Lakeshore Division of Bendix Aviation Corp., St. Joseph, Mich., as project engineer. He had served in the same position with Tractor Division, Massey-Harris Co., Racine, Wis.

C. D. MANHART is now general manager, Bendix Products Division Aircraft Products, Bendix Aviation Corp. He had been aircraft manager, Bendix Products Division. **J. A. MacLEAN,** also of Bendix Aviation Corp., has become general manager, Bendix Products Division Automotive Products. He was director of industrial relations, Bendix Products Division.

RONALD J. RONAYNE has been promoted to assistant chief engineer in the Oliver Corp., Charles City, Iowa. He was design engineer and has been with Oliver Corp. for seven years.

ELFRIED F. H. PENNEKAMP, head of Additives Technical Service Section, Enjay Laboratories Division, Standard Oil Development Co., spoke before the members of the Chemical Market Research Association, Nov. 17. His subject was "Lubricant Additives and Synthetic Lubricants."

AUGUST F. WIEGAND has become regional representative for California Oil Co., serving as local marketing supervisor for Vermont and parts of Massachusetts, New York, and New Hampshire. He had been sales engineer for California Oil.

HORRELL GUS ERICKSON has joined Chance Vought Aircraft, Inc. of Dallas, Texas, as design cost staff engineer. He is a member of SAE Aircraft Activity Committee and has served as Chairman, Vice-Chairman, and Treasurer of the Texas Section in the past few years. While serving with Temco Aircraft Corp. in Dallas, he was director of engineering.

Erickson

Keene

C. F. "CHARLIE" KEENE, manager of the Chicago Branch of Ensign Carburetor Co., has retired after 37 years of service with that company. Keene served in every department of Ensign throughout his career and moved to Chicago when the branch office was opened in 1929. His work has been outstanding in the field of automotive engineering for many years. He became a member of SAE in 1919.

GENE W. ANDERSON is now manager of Material Control Department, Ford Motor Co. Engineering Staff. Previous to this appointment he was assistant to the executive engineer, Administration, Ford Engineering Staff.

CESARE TONEGUTTI has taken the position of factory director of Alfa Romeo S. P. A. in Napoli, Italy. He was serving as director of projects in Alfa Romeo, Milan.

GEORGE A. BROWN is now serving as general manager of the Automotive Fabrics Division of J. P. Stevens & Co., Royal Oak, Mich. He was formerly manager of the Automotive Division of Goodall Fabrics, Inc. of Detroit.

EDWARD HALL RAYERMANN has taken the position of production engineer with Aerojet General Corp., Azusa, Calif. He had been serving in the U. S. Navy as chief engineer, USS Paricutin (AE-18).

D. W. ANDERSON, newly appointed sales manager of the Instrument Division of the Clary Multiplier Corp., heads an expanded national sales program for the company's guided missile products. Until recently he was general manager of the Firestone Tire and Rubber Co.'s guided missile division in Los Angeles.

DONALD BRUCE EPNER, formerly flight line crew chief for North American Aviation, Inc. at Niagara Falls Air Force Base, New York, has moved to Los Angeles International Airport as field representative of North American.

JOHN E. MITCHELL is a design engineer—diesel engine, with Caterpillar Tractor Co. in Peoria, Ill. He was previously project engineer with Baldwin-Lima-Hamilton Corp., Eddystone, Pa.

ROGER BURLEY has joined Available Truck Co., Chicago, as special representative, Sales and Special Designs. He had previously been assistant to the president of Federal Motor Truck Co., Detroit.

GEORGE WILLIAM FRUTH is a designer with Thompson Products, Inc. in Milwaukee. He had served with Le Roi Co., also in Milwaukee, as experimental engineer.

WILLIAM W. COLLINS has taken the position of director of research and development with Hamilton Tool Co. of Hamilton, Ohio. He had previously served as mechanical development engineer for E. I. DuPont de Nemours & Co., Inc. of Wilmington, Del.

ROBERT A. CUMMING, who has been sales engineer with Caterpillar Tractor Co. in Peoria, Ill., is now field representative for the Engine Division of the same company.

JOSEPH ZUBATY is employed by A. C. Spark Plug Division, General Motors Corp., as engineer in charge of special assignments. He was development engineer with Switson Industries, Ltd., Major & McAlpine, Welland, Ont., Can.

LEONARD C. NELSON is now an assistant professor at the North Carolina State College in Raleigh, N. C. He had been serving as consultant in the field of Mechanical Engineering for Electric Service Engineering Co. of Joliet, Ill.

HARRY J. SCHROEDER, who was design engineer in Food Machinery & Chemical Corp., San Jose, Calif., is now an engineer with Lakefield Mfg. Co., Milwaukee, Wis.

HAZEN H. KRAUS, formerly laboratory engineer with Chrysler Corp. in Highland Park, Mich., has now taken the position of contact engineer with that company.

FRED N. DICKERMAN has been named director of engineering of Chance Vought Aircraft, Inc., Dallas, Texas. He had been chief engineer since 1949 and has been with Chance Vought since 1933.

ALLEN W. ROMIG is now associated with Kirk Engineering Co. of Beverly Hills, Calif. as a designer. He had previously been design draftsman with Avco Mfg. Corp., Stratford, Conn.

E. J. HRDLICKA, manager of the Hydreco Division, New York Air Brake Co., Cleveland, Ohio, presented a technical paper entitled "Hydraulic Control Valves and Circuits as Applied to Lift Trucks" before the National Conference on Industrial Hydraulics. Hrdlicka has been with Hydreco since 1936 and since that time has had wide and varied experience with hydraulic motor and control design and development.

Hrdlicka

Cattaneo

ALFRED G. CATTANEO, head of the Fuels and Lubricants Engineering Department at the Emeryville, Calif. research center of Shell Development Co., has been appointed chairman of the Subcommittee on Combustion of the National Advisory Committee for Aeronautics for 1955. He has been a member of the Subcommittee since 1950. The Subcommittee on Combustion guides and assists the NACA research program on combustion in aircraft and missile power plants.

ROBERT S. SEIDEL is project engineer with White Mfg. Co., Elkhart, Ind. He had been production engineer for the Chicago Telephone Supply Corp. in Elkhart.

GEORGE MALECKI, who has been tool engineer for General Motors Overseas Operations, General Motors Interamerica Corp., Caracas, Venezuela, is now master mechanic in that corporation.

ROBERT EDWARD JOHNSON has taken the position of test engineer with the Whirlpool Corp. in St. Joseph, Mich. He was previously correspondent for Studebaker Corp. in South Bend.

The following SAE members have been elected officers of the National Grease Institute:

President, **HUGH L. HEMMINGWAY,** general manager, Sales Service Department, Pure Oil Co.; Vice President, **WILLIAM M. MURRAY,** vice president, Deep Rock Oil Corp.; Directors for 3 year term, **M. R. BOWER,** manager, Lubricating Sales, Standard Oil Co. (Ohio); **A. J. DANIEL,** president, Battenfield Grease & Oil Corp.; **G. A. OLSEN,** president, Sunland Refining Co.; **F. E. ROSENSTIEHL,** manager, Lubricating Sales Division, The Texas Co.; **WILLIAM H. SAUNDERS, JR.,** president, International Lubricating Corp.; **B. G. SYMON,** manager, Lubricants Department, Shell Oil Co.

A. E. "RED" PRICHARD, who has served as service engineer with Hall Scott Motor Co., ACF Brill Motors Co., is now in association with Engine Service Co., Casa Grande, Ariz., state distributor for Hall Scott engines.

WILLIAM E. DAVIS is now associated with Crucible Steel Co. of America, Midland, Pa., as metallurgist. He had been metallurgist and metallographist with General Motors Corp. in Detroit.

JAMES EDWARD LOVAAS is now assistant plant manager in Whirlwind, Inc., Windom, Minn. With Toro Mfg. Corp., he was chief industrial engineer.

M. F. THORNE has been named assistant to the executive vice president of the Ramo-Wooldridge Corp. in Los Angeles. Formerly he was assistant to **A. T. COLWELL,** vice president of Thompson Products, Inc. in Cleveland and also served as staff manager, Research and Development, in the same firm.

Cupit

Thorne

The DanCu Chemical Co. of which **DAN CUPIT** is partner expects its new Oklahoma City plant to be in production by the beginning of this year. Cupit says ten new products—based on a new physio-chemical theory using internal forces inherent to matter to bring about changes in molecular structure—will be on the market in Oklahoma and Texas by the spring of this year. Cupit was Chairman of the SAE Mid-Continent Section in 1948-49.

E. L. CARROLL TO RETIRE

E. L. CARROLL, Eastern Advertising Manager of SAE Journal and SAE Handbook since 1926, is retiring on Feb. 1 and will live at his home at 31 Oak Ridge Rd. in Osterville, Mass. on Cape Cod.

Carroll has been prominent in advertising sales circles ever since completion of his Army service as a 2nd Lieutenant in World War I. Before joining SAE Journal, where he spent a major part of his successful career, he had sold advertising for several Chilton Co. publications.

Besides his work in advertising, Carroll has been active in Society and civic work of various kinds. In Scarsdale, where he made his home until recently, he was Commander of Scarsdale American Legion Post 52 and served as president of the local volunteer fire department for several years. He was also president of the Green Acres Association, a civic organization, and chairman of the Scarsdale Safety Association.

A member of SAE since 1927, Carroll worked with the chairman of the Golf Committee at 25 SAE Summer Meetings and played a prominent part in the year-after-year success of the SAE golf tournaments.

Born in Dayton, Ohio and graduated from the University of Michigan with an A.B. degree, Carroll's first job was as a public speaking instructor in the high school in Cadillac, Mich. As a member of a Michigan National Guard unit, he served briefly in active service on the Mexican border from June to September, 1916; then returned to Muskegon, Mich. as a high school public speaking instructor. He joined the Chilton organization in 1919.

JOSEPH GESCHELIN, Detroit editor, Chilton Publications, is scheduled to address the Valley Engineer's Club, Waynesboro, Va., January 21. Subject of the talk is "What's New in Motor Cars for 1955?", dealing largely with the features of new engines as well as other mechanical developments. A similar talk will be presented before the SAE Washington Section, January 20.

CHARLES A. KNAPP is now associated with Wright Aeronautical Division of Curtiss-Wright Corp., Wood-Ridge, N. J., as project engineer. With the Aviation Gas Turbine Division of Westinghouse Electric Corp., he had served as section engineer.

E. G. KELLER has been appointed manager of the Pump Division of the C. A. Dunham Co., Marshalltown, Iowa. He had been serving as assistant chief engineer with Dunham in Michigan City, Ind.

G. HAROLD OSBORNE was named vice president in charge of Marketing by the Kendall Refining Co., Bradford, Pa. He had been made general manager of sales in 1950 and in 1951 was elected to the Board of Directors.

NORMAN C. WILSON has become regional service manager with Ford Motor Co., Melrose Park, Ill. Previously he was customer relations manager with Ford.

CHARLES O. McCUMBER, who has been service manager for John D. Wendell, Inc., Albany, N. Y., is now serving in the same position with Pemberton Cadillac Co., Toledo, Ohio.

GEORGE J. TZANTZOS has left the U. S. Air Force, in which he was senior aircraft navigator, and has joined Armour Research Foundation, Technology Center, Chicago, as assistant engineer.

Obituaries

W. WILBUR SHAW

W. Wilbur Shaw was killed in a plane crash Oct. 30 in Decatur, Ind. He would have been 52, Oct. 31.

He was born in Shelbyville, Ind. and attended Indianapolis High School from 1917 to 1920. Upon graduating from High School he built automobile racing engines and racing cars with Speedway Engineering Co. of Indianapolis.

During the next 14 years he served as designer, builder, and driver of racing cars for Rogers and Butcher, R. E. Dunning, Automotive Safety Devices, Inc., and Gil Pirung. He also won the 1937 Indianapolis 500 Mile Race with a car that he had designed and built himself.

In 1938 he served as consulting racing engineer with Pacific Gas & Electric Co. of San Francisco and in 1939 he joined Perfect Circle Co. of Hagerstown, Ind. as engineer. He started with Firestone Tire & Rubber Co. as manager of the Aeronautics Division in 1940. With them he served as sales manager and then director of Sales and Engineering.

Shaw became president and general manager of Indianapolis Motor Speedway Corp. in 1951 and served in that position until the time of his death.

ALEXANDER HAUSER

Alexander Hauser, Chairman of Carobronze, Ltd. in London, England, died Nov. 25. He was 67 years of age.

Besides being an active member of SAE Metropolitan Section, Hauser held active membership in many other organizations. For instance, he was a director of the Austrian Petroleum Institute, was an executive member of the New York Board of Trade with the Latin-American Section and committees of that section such as the Engineering and Post War Planning Committees, and was active in the Institute of Metals in London, American Numismatic Society, International Society of Mining Engineers, International Drillers Society of Vienna, and the International Association of Oil Engineers.

Among his honors is the Ritter Cross, first class, of the Austrian Order of Merit, which he received for his activities as an industrialist.

Hauser, after completing his studies in Trade School with honors, began his professional activities in the petroleum industry with concerns in Vienna and Boryslaw (Galicia). He remained in the petroleum industry for many years, and then in 1928 took over the direction of the Carobronze pipe works, which he reoganized after the war confusion by erecting subsidiaries and a sales organization extending all over Europe. In 1945 he served as director of the Latin-America Credit Corp. in New York, in 1946 he was vice president of Columbia Commerce and Credit Corp. in New York, and in 1951 he became managing director of Carobronze, Ltd. in London.

Hauser also held offices in many international concerns such as the "Estag" Eisen-und-Stahl A.-G. and the "Gewerkschaft Raky-Danubia" in Vienna.

JAMES H. LAHEY

James H. Lahey, factory representative of the Industrial Sales Division of Webster Electric Co., Racine, Wis., died Oct. 24.

Lahey was born in Waukegan, Ill. on July 26, 1905. He started in industry as a machinist in 1926 with Motor Grinding Co. of Milwaukee. He joined Allis Chalmers Mfg. Co. Tractor Division, West Allis, Wis. in 1929 as an engineering department representative. From then until 1943, he served in the positions of leadman instructor, machinist, leadman, and welding supervisor.

In 1943 Lahey became an instructor on the War Production Board in Chicago with a Civil Service Rating. From 1944-1946, he served as a local administrator in the Bloomington area with the University of Illinois Extension Division in Urbana, Ill.

He started with Webster Electric in 1950 as assistant sales manager of Oil Hydraulics Division. He will be well-remembered in the heating field, especially in the middle-western states where he was most active.

RALPH L. BUSSE

Ralph L. Busse, 660 Whitmore, Apt. 306, Detroit, died Nov. 8. He had been in retirement since 1951.

Busse was born in Davenport, Iowa in 1890. He attended Grade School and High School and then went to an Art Institute for one year. Later he also attended Chicago Technological Institute.

Before his retirement, Busse was vice president in charge of Sales with Timken-Detroit Axle Co. of Detroit. He had been with Timken-Detroit for 36 years, joining in 1915 as a member of the Cost Department. He served as assistant to the president and then became vice president in charge of sales.

FRANK J. OLENDER

Frank J. Olender of Indianapolis, Ind. died Sept. 8. He was president of Olender Sales & Engineering Co.

Olender was born Aug. 9, 1910 at Buffalo, N. Y. and attended Washington School in Chicago Heights, Ill. His career in engineering began upon graduation from school in 1925. He took a position as blue print boy and tracer with Durand Steel Locker Co., Chicago Heights.

After moving to Detroit, he held various positions with the following companies: Detroit Piston Ring Co., Hudson Motor Car Co., Plymouth Division of Chrysler Motor Car Co., Dibble Color Co., and Fisher Body Division of General Motors Corp.

He then moved to Flint, Mich., joining Chevrolet Motor Co. in 1934 as sheet metal band sawyer. From then until 1952 when he became vice president and general manager of Olender Engineering Service, Inc., he served in organizations such as General Motors Corp., Remington Rand, Inc., International Harvester Co., Engineering Service, Inc., and Wickes Bros., Inc.

RICHARD SIMONSEN

Richard Simonsen, partner of S. W. Perry & Associates, Perth, Western Australia, died Sept. 8. He was 49.

He started work at the age of 13 with the Harrison Emery Engineering Co. and after two years became apprenticed to Skipper Bailey Motor Co., then the agents for General Motors products in Western Australia. During his apprenticeship he attended Perth Technical School. His education was continued at Alleyns College, Surrey, England and was completed in Toodyay, Western Australia.

Simonsen served with Skipper Bailey until 1933 when he became a partner of Mason and Simonsen, Ltd. He became managing director of the company in 1934 and remained in that position until 1952. He then joined S. W. Perry & Associates as partner.

From 1943 to 1946, Simonsen served

as Lt. Colonel in the Western Command, Australian Military Forces, with headquarters in Swan Barracks, Western Australia.

Besides being a member of SAE, he also held membership in the Institute of Automotive Mechanics, and the Royal Automobile Club.

JOHN C. DAY

John C. Day, secretary, treasurer of Western Petroleum Refiners Association in Tulsa, Okla., died Oct. 5. He was 64 years of age.

Day had been with Western Petroleum since 1935, starting as technologist and secretary. Previous to this he served in engineering positions with Frisco Railway Co., H. F. Wilcox Oil and Gas Co., Waite Phillips Oil Co., and Barnsdall Oil Co., where he served as vice president.

He was born in Springfield, Mo. in 1891 and attended Drury College in Springfield. He graduated in 1910 with a degree in Civil Engineering.

As well as holding membership in SAE, Day was active in the Society of American Military Engineers.

J. LESTER DRYDEN

J. Lester Dryden died Oct. 29. He was 74. With Long Mfg. Division of Borg-Warner Corp. in Detroit, he served as vice president and assistant general manager.

Born Jan. 2, 1881 in Carrolton, Ohio, Dryden received his education in nearby Dayton. In 1911, he became manager of the Troy Body Works, a firm then fabricating wagons and wooden bodies for automobiles.

In 1912, Dryden moved to Detroit as treasurer of Long Mfg. Co., who were then building automobile radiators. He soon became general manager and a few years later was elected president of the company. He retained this office until 1953 when he was elected chairman of the board of directors.

Dryden was primarily responsible for two major contributions to the advancement of the automotive industry. He recognized the need for added beauty and protection of radiators and introduced the first automotive grills. Later in 1921, he was responsible for the final development and manufacture by Long of the Single Disc Clutch. This simplified method of easily transmitting power is used by every automobile manufacturer today.

JOHN H. NEAD

John H. Nead, metallurgical consultant to the president of Inland Steel Co., Chicago, died at his home September 13. He was sixty-eight.

Nead was a member of SAE for 43 years, serving on the Iron & Steel Panel A of the Iron & Steel Committee for many of those years. He was also a Junior Member of the American Society for Testing Materials, Past Chairman of the Iron & Steel Division of the American Institute of Mining & Metallurgical Engineers, Past Director of the American Society for Metals, member of the American Iron & Steel Institute, member of the British Iron & Steel Institute, member of the British Institute of Metals, and others.

He joined Franklin Motor Car Co., Syracuse, N. Y. in 1910 and served in the metallurgical field for Watertown Arsenal, Minneapolis Steel & Machinery Co., American Rolling Mill Co., and Inland Steel Co. He had been in retirement since April 1, 1952.

JOHN B. HANSON has been appointed to be director, Motor Equipment Division, General Services Administration, Washington, D. C. He will be responsible for the organization and management of a newly created Government-wide program of establishing and operating consolidated centrally operated motor pools in areas of high Federal vehicle density, and for initiating other policies furthering the adoption by the Government of proven commercial methods of fleet management which will decrease the cost of Uncle Sam's fleet operation.

EDWARD A. NACKE is now associated with Don Allen Midtown Chevrolet, Inc., New York as assistant general manager. He was manager of Drive-A-Car, Inc., also of New York.

JOHN E. NELSON, who has been production manager of Michrotech Corp., Pasadena, Calif., is now serving as manufacturing engineer in the Transducer Division of Consolidated Engineering Corp. of Pasadena.

JOHN B. RAUEN, SR., formerly president of U. S. Spring & Bumper Co., a division of Rheem Mfg. Co., has been named chairman of the board of Spring & Bumper. Principal products made by this company include auto bumpers and bumper guards, springs, highway guards and farm tools.

BRENT C. JACOB, JR. is chief industrial engineer of Chrysler Division, Chrysler Corp. Since 1952 he had been supervisor of quality inspection on the staff of the operating manager.

THEODORE J. STEINMETZ has taken the position of project engineer with Willys Motors, Inc. in Toledo, Ohio. During the past eight years he had served with Kaiser-Frazer Corp. in Willow Run, Mich. as project engineer.

JOHN W. THOMPSON is now associated with Parsons, Brinkerhoff, Hall, and MacDonald, Inc. of New York as consultant—aircraft maintenance engineer. Previous to this he was works manager with Pacific Airmotive Corp. in Linden, N. J.

JOHN H. WALSH has been appointed technical service supervisor, New York District, by Tide Water Associated Oil Co. He had been serving as assistant manager, Sales Engineering Department.

KENNETH MILLSPAUGH, who was contact engineer with the Budd Co. of Detroit, has moved to the Ford Motor Co. in Dearborn, Mich. as designer, Body Engineering.

EARL A. SMITH has moved to the U. S. Naval Air Turbine Test Station, Aeronautical Turbine Laboratory, Trenton, N. J., where he is a supervising power plant engineer. He had been an aeronautical power plant engineer at Naval Air Material Center, Aeronautical Engine Laboratory, Philadelphia, Pa.

WILLIAM P. WITHERS has retired from active service in the U. S. Army as Colonel, Army Field Officers Board 2, Fort Knox, Ky. He is now employed in the Johns Hopkins University, Operations Research Office, Chevy Chase, Md., as operations analyst.

L. CLAIR WILLIAMSEN, formerly engineer with Williamsen Body & Equipment Co., Ogden, Utah, has become vice president and chief engineer with that company.

JOHN J. BERGWELL is junior design engineer with Goodyear Aircraft Corp., Akron, Ohio. He had served in the same position with North American Aviation Corp. in Los Angeles.

GEORGE RICHARD THALMAN is a research engineer with North American Aviation, Inc. at International Airport in Los Angeles. He had been laboratory engineer, Chrysler Jet Engine Plant, Chrysler Corp., Detroit.

Student Members

Enter the Service

U. S. Army

Pfc. **JOHN J. BARTOLETTI**—Army Chemical Center, Md. (University of Illinois '53)

Pvt. **LOUIS J. BELTZ**—Fort Knox, Ky. (Carnegie Institute of Technology)

U. S. Navy

Ens. **JOHN J. OEFELEIN**—U. S. Naval Postgraduate School, Monterey, Calif. (Missouri School of Mines '54)

Lt. JG **JACK ZIPPERER**—Resident Naval Inspector, Garden City, L. I., N. Y. (Northwestern University '51)

U. S. Coast Guard

Ens. **JACK ALLEN PERKINS**—Juneau, Alaska (Case Institute of Technology '53)

U. S. Air Force

LESTER DALE BERGSTEN, Instructor—McConnell Air Force Base, Wichita, Kans. (Kansas State College '53)

2nd. Lt. **STANLEY J. BROCKWAY**—Chanute Air Force Base, Chanute, Ill. (Oklahoma Agricultural and Mechanical College '54)

Lt. **VINCENT N. CAPASSO, JR.**—Edwards Air Force Base, Edwards, Calif. (Purdue University '54)

A/3c. **NEAL W. DAVIS**—Chanute Air Force Base, Chanute, Ill. (Northrop Aeronautical Institute)

JOHN A. FIEBELKORN—Holloman Air Force Base, N. Mex. (Michigan State University '51)

A/3c. **JOSEPH M. FRIEDBERG**—Amarillo Air Force Base, Texas (University of Miami)

Capt. **WILLIAM R. HIPPLE**—Project officer in the flight control field (U. S. Air Force Institute of Technology '54)

A/c. **MALCOLM MAC LEOD**—Goodfellow Air Force Base, San Angelo, Texas (Academy of Aeronautics '53)

Tech./Sgt. **GENE S. RAMSBEY**—Hamilton Air Force Base, Calif. (Indiana University)

2nd. Lt. **WILLIAM KEITH OJALA**—Graham Air Base, Fla. (Michigan College of Mining and Technology '54)

WILLIAM R. PHILLIPS—Randolph Air Force Base, Texas (Missouri School of Mining and Metallurgy '54)

Lt. **ROBERT A. ROGERS**—Design Engineer (Michigan State College '53)

ROBERT C. THOMPSON—Maxwell Air Force Base, Montgomery, Ala. (Purdue University '49)

Lt. **EDWARD H. WILLIAMS**—Caribou Air Force Station, Limestone, Maine (University of Massachusetts '52)

Enter Industry

JAMES A. DALTON (Purdue University '52) is now employed with Caterpillar Tractor Co. in Peoria, Ill. in the position of service trainee. He served in the U. S. Army from July, 1952 to June, 1954.

TYMAN H. FIKSE (University of Washington '54) has taken a position with Utility Trailer & Equipment Co., Inc., Seattle, Wash. He is engineer and assistant foreman.

ROBERT L. FRANZEN (Colorado University '50) is working with Horning-Cooper, Inc., Monrovia, Calif. as engineer.

MARSHALL H. BROWN (Fenn College '54) has joined North American Aviation, Inc. in Los Angeles, as junior research engineer.

JAMES M. LYNCHEY (Detroit Institute of Technology '53) has joined the Michigan Employment Security Commission in Detroit as an employment interviewer and professional placement.

TEVFIK FIKRET ATAHAN (Purdue University '54) is now a mechanical engineer with the Brown Brock Meyer Co. in Dayton, Ohio.

LaVERN A. WAY (General Motors Institute '54) is a member of the Process Engineering Department, Harrison Radiator Division, General Motors Corp.

from the Sections

Northwest

Field Editor
S. J. McTaggart
Sept. 28

BRISK, GOOD-NATURED DISCUSSION followed the talk by Merrill C. Horine of Mack Mfg. Co. on, "More Payload Through Better Weight Distribution."

Horine opened his address with the statement, "Payload gains of as much as four tons without extra weight or price and without exceeding chassis axle or tire ratings or legal loads are possible on standard tractor semi-trailer combinations. They can be produced by **a few simple changes in the fifth wheel and semi-trailer axle locations.**" He went on to illustrate graphically and clearly the factors involved in calculating the geometric weight distribution of tractors and semi-trailers.

Mohawk-Hudson

Field Editor
J. B. Tompkins
Nov. 8

1500 TONS OF FORCE extrude stainless tubing and alloy steel shapes in the Extrusion Plant of Allegheny Ludlum Steel Corp.

Dr. G. Mohling, chief metallurgist of Allegheny Ludlum, previewed the special tour at the dinner meeting of Nov. 9. He arranged this tour with W. R. Higgins, membership chairman of the Group, who was in charge of the meeting. Allegheny Ludlum produces alloys for high temperature applications, as well as conducting basic metallurgical research.

Features of the extensive tour also included the recently completed Melting Department with **one 15 ton and two 25 ton electric furnaces.** The guests followed the path of the steel from the alloying melts to the finished products, which presented an excellent picture of the many operations involved.

Northern California

Field Editor
R. E. Van Sickle
Oct. 27

$100,000,000 WAS SPENT TO CONSTRUCT A 24 IN. PIPELINE 720 MILES ACROSS THE CANADIAN ROCKIES. Highlights associated with the building of this gigantic artery for pumping crude oil from Edmonton on the Alberta prairies to the expanding industrial areas in the Pacific Northwest were told by Ivy Lee, Jr. of Bechtel Corp.

Four pumping stations along the way can deliver **150,000 barrels of crude oil a day.** All phases of this venture—organization, training, construction, etc.—represented tremendous undertakings.

In addition to Lee's presentation, pertinent comments were made by four guests recognized as experts in fields related to this project. Included were J. S. Grepe, Jr., Standard Oil Co. of California, cur-

Wichita Nov. 12-13

From Section Cameras

Successful Utility Aircraft Meeting

OFFICIATING AS PROGRAM CHAIRMAN during the Wichita Utility Aircraft Meeting was Herb Rawdon, chief project engineer, commercial, of Beech Aircraft Corp. This two-day meeting, equipped with plant tours, technical papers, a forum on Parts Forming Operation, and a banquet, attracted a large crowd interested in the many aspects of utility aircraft.

Northern California Oct. 27

RECEIVING the Past Chairman's Certificate is J. A. Edgar. 1954–1955 Chairman J. R. MacGregor is shown making the presentation.

Northern California Oct. 27

PARTICIPATING AS A PANEL OF EXPERTS on Fuels and Lubricants are (left to right) Ivy Lee, Jr., Bechtel Corp.; W. G. Brown, Caterpillar Tractor Co.; J. S. Grepe, Jr., Standard Oil Co. of California; Charles Cox, Nordberg Mfg. Co.; J. R. MacGregor, Chairman of Northern California Section; and H. S. Hicks, Shell Oil Co.

rently a member of the TransMountain Construction Committee; H. S. Hicks, Shell Oil Co.; Charles Cox, Nordberg Mfg. Co.; and W. G. Brown, Caterpillar Tractor Co. A color movie dramatically illustrated the actual construction work on the pipeline.

St. Louis

Field Editor
Gene Kropf
Nov. 9

FOOLING AN AIRCRAFT JET ENGINE into believing it's in flight while actually it is undergoing tests in an engine facility is a tremendous job requiring almost unbelievable equipment. In his presentation, Gaylord W. Newton, chief, Engine Test Facility, Arnold Engineering Development Center at Tullahoma, Tenn., graphically brought this out in a well illustrated lecture on, "Results to be Obtained From a High Altitude Engine Test Facility." Newton was introduced by Professor Harold Hertenstein, Parks College of St. Louis University, chairman of Aircraft Activity for the Section.

Speaking before a well attended meeting, Newton, who is also SAE National Vice-President for Aircraft Powerplant Activity, traced the development of such a test facility from its origin in Germany during World War II to the present facilities operated in Tullahoma. He stated that a considerable amount of the German equipment is now being used for our research work. He explained how **conditions in the test cells must be identical with those the engine will face in actual flight,** and since these conditions are so variable because of temperature changes with altitude and various speed requirements, the facilities must of necessity be able to cope with all possible conditions.

At present the facilities may be used only by manufacturers who have secured proper priority and for whom scheduling arrangements have been made with the Air Force. In the near future with expanded facilities, the Center hopes to be able to make the equipment available to any manufacturer on a proper cost basis.

Attendance and door prizes were won by students from the Parks College Student Branch. A musical interlude featuring Hawaiian Students at St. Louis University preceded the meeting.

Baltimore

Field Editor
H. T. Cline
Nov. 11

THE PLIGHT OF THE FLEET OPERATOR RESEMBLES THAT OF "THE OLD WOMAN WHO LIVED IN A SHOE" when it comes to selecting lubricating oils. That is the description given by W. A. Howe, engineer with the Gulf Oil Co., with regard to the many oils offered the operator by the petroleum industry.

Howe reviewed both the American Petroleum Institute and the Internal Combustion Engine Institute service designations and also presented some of his own. He presented many illustrations showing engines that were run on various additive level oils under unfavorable conditions. The information on gasoline, diesel and Liquefied Petroleum Gas engines contained in this paper did much to explain the types of oils and the types of service in which they should be used.

Atlanta

Field Editor
D. J. Tolan
Nov. 1

DYNAMOMETER TESTING IS GAINING ACCEPTANCE IN LARGER FLEETS, according to E. L. Tandrum, Ethyl Corp. Technical Service Department, in describing equipment requirements for fleet maintenance. The economics of tool procurement and repair procedures were covered in his talk.

Central Illinois

Field Editors
Y. M. Miller
E. E. Hanson
Nov. 22

TIRE MILEAGE HAS INCREASED FROM 11,000 TO 40,000.

R. D. Evans, tire design consultant to Goodyear Tire and Rubber Co., defined the modern pneumatic tire as a "mass of stresses" during his explanation of their properties, application and construction.

He stated that some of the properties required by the users of passenger car tires would include: **long and trouble-free life, a soft and quiet ride, good traction and non-skid characteristics, good stability, and low rolling resistance.** The demand for a soft ride has caused tire pressures to drop from the 50 lb in early years to 24 lb today.

Meanwhile, aircraft tire pressures during the past 20 years have increased from 38 to 260 lb, with 300 lb of pressure just around the corner.

Buffalo

Field Editor
D. I. Hall
Oct. 27

THERE IS ONE CAR FOR EVERY THREE PEOPLE IN THE UNITED STATES and 77% of all the things we use are transported by truck.

57 members and guests attended the dinner meeting of the Rochester Division of the Buffalo Section where the guest speaker was F. H. Sexauer, chairman of the National Highway Users Conference.

Sexauer presented an interesting talk on our high-

Chicago Nov. 15

SPEAKING AS TECHNICAL CHAIRMAN is Wm. J. Harris, Studebaker-Packard Corp. He is shown at the speaker's table with (left to right) Wyn E. McCoy, Timken Roller Bearing Co.; L. C. Daniels, Buda Co.; Glen R. Johnson, speaker, Clark Equipment Co.; T. H. Thomas, Bendix Aviation Corp.; M. P. deBlumenthal, Studebaker-Packard Corp.; W. E. Rice, Clark Equipment Co.; and John Keresztury, Bendix Aviation Corp.

Central Illinois Nov. 22

INSPECTING A TIRE SAMPLE following the illustrated talk by R. D. Evans on Modern Pneumatic Tires are (left to right) A. H. Pickford, technical chairman of the meeting; R. D. Evans, speaker; and R. Roman, the Section chairman.

Mid-Michigan Dec. 7

SEATED TOGETHER at the meeting are Prof. J. E. Arnold of Massachusetts Institute of Technology, (left) speaker on Engineering Creativity; and R. K. Hirchert, Section chairman.

way problem, tracing the origination of our system and its development from the social, economic, and political points of view. The highway system is now an integral part of our lives.

The National Highway Users Conference encourages use of **the conference method** with all decisions, in order to arrive at recommended solutions to our highway problems.

Southern New England

Field Editor
A. D. Nichols
Dec. 1

WHEN THE PRESENT FACILITIES, KNOW-HOW, AND TRADITION IN THE MANUFACTURE OF THE PART CAN BE COMPLETELY DISCARDED, Automation is best accomplished in the production of a part, said Charles F. Hautau, chief engineer of Hautau Engineering Co., Detroit.

Automation is not only the complete manufacture of a part automatically, but loading and unloading a part in a machine, and adjustment of machines without human operation. These machines actually anticipate error and make corrections after each machining operation is completed. This eliminates mating of parts where tolerances are closely controlled. The machines are also continually compensating for their own wear.

Electronic gages and measuring devices are responsible for the elimination of human inspection of a part. It is possible for one gage to handle the operation of several machines. This gage can reject a defective part and also correct or shut down the machine producing that part. Since the machines anticipate error and make corrections accordingly, waste is practically eliminated.

A movie of automation as applied to several manufacturing companies was shown.

Texas

Field Editor
H. C. Anderson
Nov. 12

THE FIRST MAN TO FLY A VERTICAL TAKE-OFF AIRPLANE was J. F. Coleman, whose talk highlighted the November meeting of Texas Section. This airplane, known as the XFY-1, takes off and lands straight up and down.

Coleman presented two films of the VTO. One film showed the first tethered flight tests of the plane. Inside a huge hangar, the plane was attached to a number of cables. These were arranged in such a fashion that should the plane suffer a loss of power, the cables would keep it in the air and prevent a crash.

After dozens of tests in that fashion, Coleman made his first take-off straight up—and his first landing, backing straight down.

A second film showed the plane as it rose into the air, then leveled off for conventional flight before coming in vertically for a landing.

Coleman pointed out that the XFY-1 is the "world's fastest and slowest" flying airplane. Its top speed cannot be disclosed, but it is designed to fly upward of 500 mph.

To describe the maneuverability of this airplane and the accuracy with which the airplane could be landed, Coleman stated, "I could back it down on the tops of four barrels."

O. F. Oldendorph, of the Convair San Diego XFY-1 Project Office, presented interesting data on research which led to the actual construction of the VTO airplane.

The second highlight of the evening was given by Jim Burridge, chief engineer on Glen L. Martin's "Matador." Burridge told of the many problems involved in the design, application and early use of the honeycomb in aircraft wing construction.

The honeycomb process involves sandwiching honeycomb-like Fibreglas between two sheets of aluminum. This produces a surface which is many times stronger than the two sheets used alone. At the same time, it is much lighter than enough aluminum of equal strength would be.

Southern California

Field Editor
W. E. Achor
Nov. 8

THE 70,000 LB A3D SKYWARRIOR IS THE LARGEST AIRPLANE NOW BEING BUILT FOR CARRIER OPERATION according to H. A. Nichols, project engineer for Douglas Aircraft Co., Inc. El Segundo Division. Nichols went on to explain that this 70,000 lb attack plane flies in the 600 to 700 mph range and is capable of flying at 40,000 ft. It will carry mines, torpedoes, and bombs, including atomic weapons.

Two J-57 engines are used, but their combined thrust of 20,000 lb is boosted to 50,000 lb with the use of **12 jettisonable JATO units.** Escape is provided through an escape chute and a bottom fuselage skin door which is opened by cartridge fired cylinders. It was also observed that the requirement for a tail turret resulted in an overall increase of airplane weight by 12,500 lb.

Field Editor
W. E. Achor
Nov. 22

POLYGLYCOL VERSUS DIESTER SYNTHETIC LUBRICANTS was discussed by D. W. Bedell, Esso Standard Oil Co., during the panel meeting entitled, "Synthetic Lubricants for Turbine-type Engines."

The panel members were in agreement in only two general conversational areas—that these synthetic lubricants have an extremely disagreeable smell, and that there is still a lot of learning to be done concerning the use of these synthetic materials.

At present Diester synthetics are the only satisfactory answer according to laboratory tests and engine operation. Up to a specific maximum temperature, Polyglycol synthetics may be somewhat better than Diesters, but they fail rapidly above that maximum temperature. Bedell went on to say that

From Section Cameras

Texas Nov. 12

VERTICAL TAKE-OFF is discussed by O. F. Oldendorph, Convair XFY-1 project office; J. F. Coleman, VTO pilot; Jim Burridge, Glenn L. Martin Co.; and B. G. Reed, Convair Fort Worth.

Detroit Nov. 15

CONVERSING AFTER THE MEETING are R. G. Wingerter, Timken Roller Bearing Co.; M. M. Roensch, Ethyl Corp.; John A. C. Warner, SAE secretary and general manager; and M. B. Terry, American Brake Shoe Co.

Detroit Nov. 15

GATHERED FOR CONVERSATION are (left to right) G. J. Huebner, Jr., Chrysler Corp.; Speaker Wernher von Braun; and Whitney Collins, Continental Aviation & Engineering Corp.

every engine reacts differently to these oils and the end function must be determined in actual use in spite of all sorts of laboratory tests which may have been run in advance. To gain acceptance, a new oil must pass 100 hr of environmental testing in a J-57 engine.

The personnel using and handling the synthetic oils must be educated concerning its properties and limitations. This point of view was expressed by C. S. Brandt, design specialist, Convair, San Diego.

D. H. Moreton, project coordinator, Synthetic Fluids and Lubricants, Douglas Aircraft Co., Inc., Santa Monica, stated that an oil with a viscosity of 3000 centistokes instead of 12,600 centistokes, at minus 65 deg, is desirable. At the same time, it should have no less viscosity than the present oils at the high temperature end of the range.

Synthetic oils are used for more than just the engines, observed A. G. Valles, process engineer, Northrop Aircraft, Inc. Disadvantages are that synthetic oils are not good for zinc plate, and cadmium plating corrosion is accelerated with the synthetic oils when friction is present.

Chicago

Field Editor
Peter Polko
Nov. 15

NO SATISFACTORY FORMULA HAS BEEN DERIVED for computing the exact floor loading exerted by a loaded truck of the Fork type. This is a challenge to the engineer.

Speaking before approximately 75 members and guests, Glen R. Johnson, sales manager, Gas Equipment Division, Clark Equipment Co., presented a paper on "Fork Trucks—Design, Application, and Operation." Johnson discussed the many factors considered in justification of adopting Fork Trucks for material handling. He pointed out that not only **cost savings, greater production, improved quality, and flexibility,** but also **employee morale** in making a job easier with no saving in cost is also an important consideration in many cases.

To apply Fork Trucks efficiently to material handling problems, five basic questions must be answered:

1. What type of material is to be handled?
2. How much material—in tons?
3. How many items are to be handled?
4. How often will they be handled?
5. How far must the truck be moved?

Detroit

Field Editor
W. F. Sherman
Nov. 15

A MANNED SPACE SATELLITE moving in an orbit 1,000 mi above the earth's surface is possible within the next 10 to 15 years, according to Dr. Wernher von Braun, chief of United States Army Guided Missile Development. Von Braun expressed this view before the largest turnout of the Detroit Section's season on Monday, Nov. 15.

He said that flight into outer space no longer involves the questions of possibility or feasibility, but rather those of how and when. He emphasized that a satellite space station, which could be used for military observation or as a base for further flights to Mars or the Moon, could become a reality in the fairly near future, if plans in that direction are immediately initiated and funds allocated.

He suggested that the already considerable amount of knowledge available on rocket flight would be one of the building blocks leading to the establishment of the proposed satellite stations. Von Braun's paper indicated that one of the areas which would require extensive study was that of human behavior under zero gravity conditions. Even here some experience has already been obtained by pilots operating supersonic aircraft. For short spaces of time these pilots have encountered zero gravity without ill effect, he said.

K. E. Coppock, chairman of the Detroit Section last year, was presented with a certificate of appreciation by John A. C. Warner, SAE general manager.

—Submitted by G. J. Gaudaen

Wichita

Field Editor
G. W. Jones
Nov. 12-13

THE VERY SUCCESSFUL TWO-DAY UTILITY AIRCRAFT MEETING was held with a total registration of 213. There were 246 in attendance at the Friday evening dinner and the social hour that preceded the dinner.

The two day meeting was started Friday morning with a visit to the local aircraft manufacturing facilities. The Friday afternoon meeting consisted of five papers. The first paper was titled, "Systematic Series of Engines for Utility Aircraft," and presented by W. A. Wiseman, chief engineer of Continental Motors Corp. The second paper was presented by Obed Wells, project engineer of Cessna Aircraft Co. and was titled, "Structural Design and Static Testing of Utility Aircraft." The third paper was on the same subject as the second paper and was presented by Carl Prewitt, structures engineer of Beech Aircraft Corp. The fourth paper was on "Propeller Design for High Performance Utility Aircraft," presented by David Bierman, general manager of Hartzell Propeller Co. The last paper to be presented Friday afternoon was by Gil Quinby, sales manager of National Aeronautical Corp. and titled, "Radio-Communication-Navigation Equipment for Utility Aircraft."

A social hour and dinner meeting was held Friday evening. After the dinner Cliff Titus of Beech Aircraft made a talk on "The Growing Importance of the Businessman's Aircraft."

Two simultaneous meetings were held Saturday morning. One of the meetings was started by a paper on "Simplified Inspection Techniques," presented by Paul Allen, director of Quality Control of Beech Aircraft. This paper was followed by a paper presented by Del Roskam, vice president of Cessna

St. Louis Nov. 9

PRINCIPALS OF "AVIATION NITE" are (left to right) Prof. Harold Hertenstein, Parks College; Gaylord W. Newton, Arnold Engineering Development Center, speaker; Harold Glidewell, Section chairman; and Rev. J. C. Choppesky, S. J., Regent and Acting Dean, Parks College.

Atlanta Nov. 1

APPEARING BEFORE HIS TALK is E. L. Tandrum, Ethyl Corp. technical service department.

Pittsburgh Nox. 23

STANDING TOGETHER (left to right) are H. A. Bigley, Jr., technical chairman; H. J. Grance, Jr., speaker from Gulf Oil Co.; and H. Kenneth Siefers, Section chairman.

Oregon Oct. 9

PRESENTATION of the Past Chairman Certificate is shown at the left. Eugene Connell, Master of Ceremonies (standing left) delivers the Certificate to Clarence Bear, past chairman.

ACCEPTING THE CHAIRMANSHIP of Oregon Section is T. E. Bokemeier.

Aircraft on "A General Production System for Production of Aircraft." This meeting was concluded by a paper on the "Development of the Piper Twin Engined Apache," presented by Walter Jamouneau, chief engineer of Piper Aircraft Corp.

The other Saturday morning meeting was started with a paper presented by Ted Smith, vice president of Aero Design & Engineering Co. on "Coordination of Tool Design and Manufacturing Procedures." The next paper was presented by T. Conway, Engineering Department of AVCO Manufacturing Corp. on the "Machining Techniques for Precision Machine Parts."

This meeting was concluded by a forum on the parts forming operation. This forum consisted of three papers, the first of which was "Forming Aluminum Sheet Metal Parts," presented by David E. Brehm, factory superintendent of Cessna Aircraft. The second paper was presented by Robert Owen, manager of Manufacturing Engineering of Beech Aircraft, concerning the "Forming of Magnesium Sheet Metal Parts." The last paper of the forum was presented by Fred Landgraf, chief engineer of Industrial Plastics Co., on the subject of "Fabrication of Parts in Fibreglas."

Pittsburgh

Field Editor
D. W. Gow
Dec. 3

COMPROMISES OF HIGH AND LOW VOLATILITY are required when adjusting motor fuel to provide best over-all performance in customer cars. This was emphasized by H. J. Grance, Jr., product technologist, Domestic Marketing Department, Gulf Oil Corp., in his paper concerning the effects of various physical and chemical properties of gasoline on engine performance.

High volatility is desirable from some standpoints, such as cold starting, warm-up and reduction in engine deposits, while low volatility is preferable for minimizing hot starting and stalling, vapor lock and carburetor icing problems. For the most part counteracting forces are not experienced with other fuel properties, such as antiknock quality, resistance to corrosion and gum formation, and control of combustion chamber deposits. Improvements made in these characteristics of a gasoline will normally produce no detrimental effect on other characteristics.

Mid-Michigan

Field Editor
R. D. Jacobs, II
Dec. 7

"THE ONLY CREATIVE TOOL MAN HAS IS THE INDIVIDUAL MIND AND SPIRIT OF A MAN." This is the firm belief of John E. Arnold, assistant professor of Mechanical Engineering at the Massachusetts Institute of Technology.

In addition, he stated that the creative mind is the kind of mind which can easily imagine many solutions to a problem and which can try many different approaches without losing sight of the goal.

The analysis by Professor Arnold provided a very interesting evening on the subject of "Engineering Creativity" for the Mid-Michigan Section meeting at the Elks Temple in Flint, Mich. on Nov. 15. A brisk question period followed Arnold's presentation.

Washington

Field Editor
Bob Auburn
Nov. 16

THE "MIGHTY MITE" WILL BE IN THE THICK OF THE FIGHT, according to R. A. Peterson, chief engineer of Mid American Research Corp. This new and revolutionary vehicle fills the need for high mobility, maneuverability, and versatility for adaption to various infantry tasks. The "Mite" is designed to be air transportable by helicopter and would be used for casualty evacuation, communications, general cargo resupply, reconnaisance, and prime mover.

The low weight of 1500 lbs is achieved by a tubular structure, aluminum gear cases and engine. Known as a $\frac{1}{4}$ ton, 4 × 4 vehicle and powered by a 44 hp air cooled engine, it has outstanding mobility and traction in all terrain, and can climb 87% grades.

Design features include a patented suspension of **independent leading and trailing radius arms, four-wheel drive, locking differential,** and for riding comfort, a patented **floating seat cushion.** Also available is a fording kit, including sealed engine container and snorkels, which can be installed in 12 sec.

Peterson made the first public announcement that negotiations were officially completed between Mid American and American Motors Co. on the manufacture of various products, including the Mighty Mite as designed and developed by Mid American. The basic ideas in the "Mite" have been incorporated in a U. S. Post Office mail truck.

Montreal

Field Editor
P. E. Falkner
Nov. 16

WITHOUT PREVIOUS MILITARY HOURS OF OPERATION and yet in full production and airline operation is the Rolls Royce Dart Engine.

Rolls Royce of Canada, Ltd., took over the Montreal Section meeting for November in a big way. Besides being hosts for the evening, they had two speakers in the persons of Air Commodore E. R. Pearce, who spoke on aircraft jet engines, and R. H. Whiteside, manager, Diesel Engines, who spoke on their full line of diesel engines.

A highlight of Pearce's talk was his description of the Rolls Royce Dart Engine. This is the engine that powers the Vickers Viscount, recently purchased by Capital Airlines in the United States, as well as Trans Canada Air Lines in Canada.

Student Cameras

Northrop Aeronautical Institute

CONFERRING with Faculty Advisor Thomas E. Depkovich (standing left) at an officer's meeting of Northrop Branch is Chairman Clyde S. Burkhardt.

PLANNING FOR THE FUTURE with SAE West Coast Manager E. W. Rentz, Jr. (right) are officers and committee chairmen. Activities of the Branch have included a tour of American Helicopter Co. and a talk by J. W. Oehrli of McCulloch Motors Corp. on the McCulloch Supercharger.

California State Polytechnic College

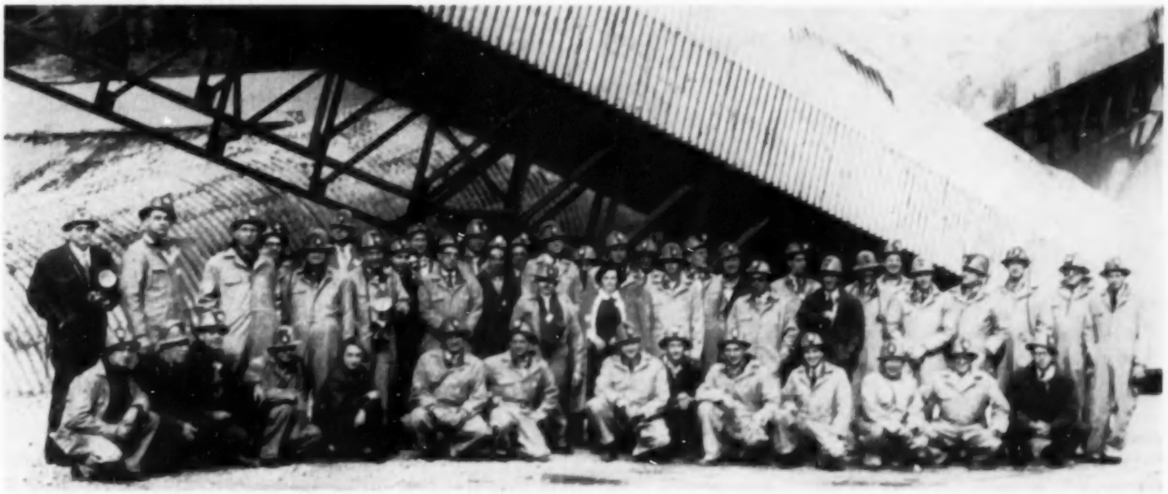
OFFICERS of the Cal-Poly Branch, appearing with speaker J. H. Pickup (left), Champion Spark Plug Co., at the first meeting of the year, are (left to right) Vice Chairman J. Schield, Chairman R. Reichman, Secretary G. Wedemeyer and Treasurer J. Salter.

Student Cameras

University of Cincinnati

WELCOMING Patrolman Carl Poppe of Cincinnati Police Department is Chairman J. Jackson. At the right, officers of the Branch stand with Patrolman Poppe. They are (left to right) Faculty Advisor D. J. Schleef; E. B. Lohaus, member of SAE Cincinnati Section; Chairman J. Jackson; Vice Chairman B. Wrenn; Secretary D. Tope; and Treasurer C. Botts.

University of Colorado



TOURING the Climax Molybdenum Plant are about 50 members. They were treated to a memorable miner's lunch and a tour through the mine. Other meetings of the branch included talks by Floyd Clymer, automobile historian; Lloyd Williams, Cummins Engine Co.; and M. C. Horine, Mack Mfg. Corp.

TECHNICAL COMMITTEE *Progress*

SAE Technical Board Approvals

THESE actions have been approved recently by the SAE Technical Board.

Tractor Power Take-off Terminology: On the recommendation of the Tractor Technical Committee the following terminology has been adopted:

Transmission Driven Power Take-off—Power to operate both the transmission and the PTO is transmitted through a master clutch, which serves primarily as a traction clutch. The PTO operates only when the master clutch is engaged. The transmission driven power take-off ceases to operate at any time the master clutch is disengaged.

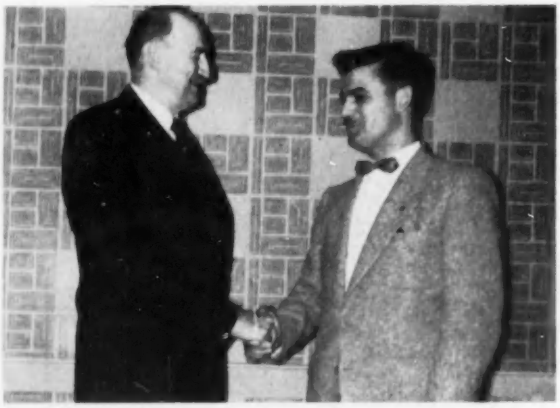
Continuous Running Power Take-off—Power to operate both the transmission and the PTO is transmitted through a master clutch. Both operate only when the master clutch is engaged. Auxiliary means are provided for stopping the travel of the tractor without stopping the power take-off. The continuous running power take-off ceases to operate at any time when the master clutch is disengaged.

Independent Power Take-off—Power to operate the transmission and power take-off is transmitted through independent transmission and PTO clutches. Travel of the tractor may be started or stopped by operation of the transmission clutch without affecting operation of the independent power take-off. Likewise, the power take-off may be started or stopped by the PTO clutch without affecting tractor travel.

Wheel Mounting Elements: The Tractor Technical Committee has revised the Recommended Practice dimensions for all wheel mounting elements in a series of implement disc wheels with rim diameters including 16, 20, 24, 26, and 28 in. and with a wide variety of offsets. Discs may be reversible or nonreversible, concave or convex offset. The maximum diameter of the hub pilot is 6.000 in. Eight holes of $\frac{9}{16}$ or $\frac{5}{8}$-in. hub-attaching bolts, 90 deg countersunk, on both sides if reversible, are provided. The attaching bolt circle is 8.0005–7.995 in. The hub flange diameter is $9\frac{9}{16}$–$9\frac{7}{16}$ in. The disc will not carry the implement manufacturer's stamped brand.

Disc Halves Interchangeability: To allow interchangeability of disc halves for agricultural press and gage wheels, no matter who the manufacturer is, the Tractor Technical Committee has set up Recommended dimensions. Rim contours and number and dimension of tire driving lugs are the same as

Drafting Leadership Changes Hands



Otto E. Kirchner, for 10 years chairman of SAE Committee S-1, recently resigned his post. As a token of their appreciation for his inspirational leadership, members of the Committee presented Kirchner with an inscribed certificate. In the photo at left, Kirchner (at the right), is shown receiving the certificate from SAE Past President Arthur Nutt. In the right-hand photo, Kirchner is turning the reins over to the new chairman of Committee S-1, P. G. Belitsos, of General Electric.

The Committee also gave recognition to one of its most active members, W. B. Billingham, for a perfect attendance record at the more than 40 Committee meetings.

those set up by the Press and Gage Wheel Task Group of the Agricultural Tire and Rim Standards Subcommittee of the Tire and Rim Association.

Tractor Disc Wheels: A new Light Series, 15-in. diameter with 3/8 in. offset, has been added to SAE Recommended Practice on rim size, tire size, and load for tractor and implement disc wheels. The maximum load is 1250 lb.

Instrument and Cockpit Lighting: The Recommended Practice for commercial transport cockpit lighting has been made into an Aeronautical Standard. SAE Committee S-7, Cockpit Standardization, suggested the change because the Practice has now gained a strong position and its wide spread use qualifies it as an AS.

Cover Plates: In an attempt to clarify the dimensions of cover plates for engine accessory drives, the SAE Standard has been revised, according to proposals made by the SAE Committee E-25, Engine and Propeller Standard Utility Parts.

Leaf Springs Standard Revised: Long standing differences between spring manufacturers and producers of leaf spring bar steel have been resolved by a revision in the SAE Standard for Leaf Springs. Width, thickness, flatness tolerances, straightness, and edge radius have been modified in accordance with recommendations by the SAE Spring Committee and Panels A, C, and D of the Iron and Steel Technical Committee.

Cable Terminals: Revisions in the SAE Standard for Cable Terminals include the following:

Terminals may be applied by crimping, welding, swaging, soldering, or any combination, and attached in accordance with the manufacturers recommendation. When assembled, the terminals should securely grip the conductor and, when applicable, the insulation.

Truck Overall Widths: For general information, a reference chart has been prepared to indicate the overall widths across dual tires when requirements of frame widths, spring widths, chain clearance, and wide base rim sizes are considered, in accordance with best engineering practice. Necessary overall widths across dual tires required using the various popular tire sizes to provide:

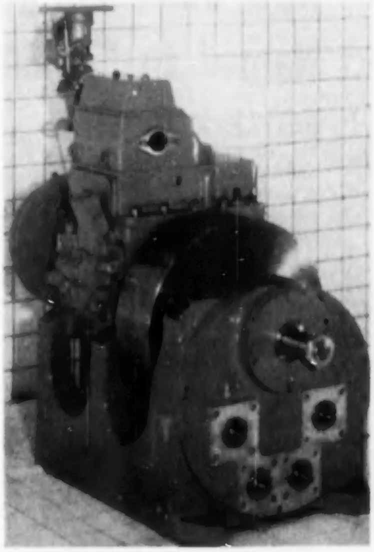
1. SAE Standard width
2. spring centers for vehicle stability
3. chain clearance between tire and spring; also between dual tires—according to Chain Institute, Inc.
4. wide base rims and tire spacing—according to Tire & Rim Association standards.

New CLR Oil Test Engine to Replace L-4

THE new CLR oil test engine was displayed for the first time at the SAE National Fuels and Lubricants Meeting in Tulsa, November 3, 1954.

Because the test engine currently being used for the evaluation of the military lubricating oils would no longer be available after 1956, the Coordinating Research Council appointed a survey team which personally contacted approximately 40 laboratories from the automotive and petroleum industry. Based on their recommendations, the CRC formulated an over-all set of design requirements for a cooperative oil test engine.

A first batch of 25 of these engines is being built by the Laboratory Equipment Corp. in Mooresville, Indiana for the CLR Oil Test Engine Group. They are to be used in the individual petroleum and equipment company laboratories to make sure that the engine fulfills the design requirements which were originally set down. Then they are to be used to develop techniques for the evaluation of lubricating oils.



The Coordinating Research Council will present a paper describing the development of this engine at the Fourth World Petroleum Congress, to be held in Rome, Italy, in June, 1955.

New Manual Explains Seating Fundamentals

FOR engineers who want to know the fundamentals of automotive seating, a subcommittee of the SAE Passenger Car Body Engineering Committee has prepared the SAE Seating Manual.

It describes current practices in the design, construction, and testing of seat adjusters, seat frames, seat spring assemblies, pad supports, padding, seat covering materials, and trim fasteners. Nomenclature and test methods are also included.

The manual contains more than 100 illustrations, and its text is factual and detailed. For example,

1. Under "Intermediate Pad," it describes curled hair as "a blend of hog, cattle tail, or horse mane hair spun into a tight rope either by hand or machines, boiled and cured in order to set the curl. After the curing-in period, the spun rope is opened or unwound and the hair spread out mechanically to a specified thickness and weight. May be interlaced or sewn to burlap or sheeting."

2. In the the chapter on seat covering materials, the section on the permanency-of-color test explains "The test is conducted by masking a portion of the material and comparing the masked and unmasked portions after a standard exposure time. Fadometer tests are based on 24-, 48-, and 96-hour exposures at 140 F in circulating air. The Florida test is usually based on 180 hours of sunlight."

Edwin C. Pickard

The manual is the work of the Automotive Seating Subcommittee of the SAE Passenger-Car Body Engineering Committee. Serving on the Subcommittee have been E. C. Pickard, chair-

New Chairman and 6 New Members Named to '55 SAE Technical Board

CHARLES A. CHAYNE has been named chairman of the SAE Technical Board for 1955. He is vice-president in charge of the engineering staff for General Motors Corp.

Chayne succeeds William M. Walworth whose term as chairman of the Board expires with the meeting of the Board on Jan. 13, 1955.

Chairman

Charles C. Chayne

Six new board members were also appointed by SAE President-Elect C. G. A. Rosen to terms expiring at the end of the 1957 administrative year. They are L. L. Bower, A. T. Colwell, R. F. Kohr, A. G. Loofbourrow, E. F. Norelius, and A. E. Smith.

Bower is chief engineer of Waukesha Motor Co. Colwell is vice-president of Thompson Products. Kohr is director of the general engineering office of Ford. Loofbourrow is assistant chief engineer in charge of administrative functions of Chrysler's chassis design section. Norelius is a consulting engineer for Allis-Chalmers. Smith is assistant to the engineering manager of Pratt & Whitney Aircraft.

Board members who will continue in office are B. B. Bachman, D. P. Barnard, O. A. Brouer, G. E. Burks, H. E. Churchill, F. W. Fink, E. G. Haven, W. C. Lawrence, C. E. Mines, Harold Nutt, and B. G. Van Zee.

Members whose terms expired at the end of the 1954 administrative year were P. C. Ackerman, H. W. Browall, E. S. Macpherson, A. F. Meyer, F. N. Piasecki, and Walworth.

L. L. Bower

A. T. Colwell

R. F. Kohr

A. G. Loofbourrow

E. F. Norelius

A. E. Smith

man, Ford; L. W. Anderson, Firestone Industrial Products; G. Barnes, Goodyear Tire & Rubber; H. Borish, Nash; V. A. Buck, Chrysler; H. C. Carpenter, L. A. Young Spring & Wire; J. D. Caton, Chrysler; C. Cenzer, Hudson; W. A. Clark, L. A. Young Spring & Wire; K. E. Coppock, Fisher Body; G. F. Doyle, Ford; A. R. Dulzo, Allen Industries; J. C. Gordon, Gordon-Chapman; C. H. Graham, Fisher Body; E. Herider, Standard Steel Spring; V. H. Hoehn, U. S. Rubber; J. M. Hussvar, Studebaker; W. E. Lay, University of Michigan; O. Martens, Briggs Manufacturing; F. C. Matthaei, Jr., American Metal Products; F. B. Nair, Standard Steel Spring; W. H. Neely, Universal Wire Spring; W. A. Radke, Studebaker; H. E. Rose, Fisher Body; F. A. Sawyer, U. S. Rubber; D. J. Schrum, Studebaker; C. E. Smith, Universal Wire Spring; D. Sprinkle, Goodyear; M. Stubnitz, Stubnitz-Greene Spring; V. L. Vandinter, U. S. Rubber; R. J. Williams, American Metal Products; and N. Wolofski, Stubnitz-Greene Spring.

Aero Materials Specs Reviewed by Industry

DRAFTS of four SAE Aeronautical Materials Specifications are currently being circulated to industry for comment and criticism by the SAE Aeronautical Materials Specifications Division. Five specifications have been approved recently by the SAE Technical Board.

Copies of all of these specifications are available for review from the SAE Aeronautical Department, 29 West 39 Street, New York 18, N. Y.

The specifications under review are:

- AMS 2640E—Magnetic Particle Inspection;
- AMS 3620B—Plastic Moldings & Extrusions, Polystyrene;
- AMS 7292—Metal Foil Nameplates (Anodized);
- AMS —— Titanium Sheet and Strip, Annealed—40,000 psi Yield.

The approved specifications are:

- AMS 2403C—Nickel Plating;
- AMS 2481B—Phosphate Treatment, Anti-Chafing;
- AMS 2485B—Black Oxide Treatment;
- AMS 5527A—Steel Sheet and Strip, Corrosion and Heat Resistant;
- AMS 6418B—Steel.

TURBOPROPS Vs. TURBOJETS . . .

. . . debated at ASME sessions cosponsored by SAE. Conclusion: There is a place for each in transport field.

WHAT this country needs to satisfy its growing air logistics requirements is a coordinated family of transports, not just competing new designs. The short-range, moderate-speed transports probably should be turboprop powered. The longer-range, high-speed transports should be turbojet powered. The very-long-range transports forming the main stem of the logistic pipeline should be turboprop powered.

This was the impression left by four sessions of Theme I, "Air Cargo and Air Logistics," of the aviation program at the Annual Meeting of the American Society of Mechanical Engineers.

SAE cosponsored the aviation program, and SAE members were admitted without payment of the registration fee. The eight sessions were held Monday-Thursday, Nov. 29-Dec. 2, 1954, at the Hotel Statler in New York. Theme II of the program was "The Thermal Barrier," and Theme III was "Turbojet Components."

Theme I speakers emphasized in talking about turbine-powered transports that currently available turboprops do not represent the best that can be achieved. Turboprops have not been developed to the point that turbojets have. The reason is that military contracts have not supported turboprop development to the extent that they have turbojet development.

Many were the pleas that Air Force Research and Development funds be allocated to turboprop development. What with the high cost of developing an engine, the low volume of non-military engine business, and high taxes on profits, engine builders can't afford to develop the turboprops we need unless they get military contracts for them.

Theme II speakers disclosed that aeronautical engineers are planning to take advantage of aerodynamic melting to absorb and dissipate aerodynamic heat. Aluminum melts at Mach 5 and steel at Mach 6, even though objects of these metals travel at these speeds in highly rarefied air at temperatures far below freezing. Providing extra metal and letting it melt away during flight may be one answer to skin cooling problems.

Four other ways of relieving aerodynamic heating were discussed. They are: (1) use of reverse thrust to decelerate a missile before it reenters high-density air, (2) use of large drag-to-weight ratios, (3) insulation, and (4) transpiration—or "sweat"—cooling whereby a fluid forced through a porous surface cools it by evaporation.

Supersonic flight adds so much heat to the fuel system that fuel is not the ideal heat sink that it might appear to be at first, one speaker pointed out. He and others preferred mechanical refrigeration for cooling certain turbine-engine components.

For cooling crew compartments, the simple water evaporative system looks good, a team of designers reported.

But the combination of cooling problems encountered under aerodynamic heating conditions may limit sustained flight to Mach 3.5. Current high-temperature materials withstand temperatures up to about 1800 F. However, the weight penalty from deterioration of physical properties may limit sustained flight to the speed which heats metals to only around 800 F. That speed is about Mach 3.5.

Theme III speakers discussed fuel controls for jet engines. An engine simulator is a useful tool for the dynamic testing of fuel controls, it was reported.

L. R. Hackney was chairman and Cliff Roberts of Boeing was vice chairman for Theme I. George T. Hayes of Stanford Research Institute's Washington office was chairman and Dr. George Gerard of New York University was vice chairman for Theme II. F. T. Harrington of Vickers was chairman for Theme III.

SAE GOLDEN ANNIVERSARY NATIONAL MEETINGS . . .

January 10-14, 1955
Annual Meeting and Engineering Display
The Sheraton-Cadillac Hotel and Hotel Statler, Detroit, Mich.

February 28, 1955
Automotive Ordnance Day, Detroit Arsenal, Center Line, Mich.

March 1-3, 1955
Passenger Car, Body and Materials Meeting
The Sheraton-Cadillac Hotel, Detroit, Mich.

March 14-16, 1955
Production Meeting and Forum
Netherland Plaza, Cincinnati, Ohio

April 18-21, 1955
Aeronautic Meeting, Aeronautic Production Forum, and Aircraft Engineering Display, Hotel Statler and McAlpin Hotel, New York, N. Y.

June 12-17, 1955
Summer Meeting
Chalfonte-Haddon Hall, Atlantic City, N. J.

August 15-17, 1955
West Coast Meeting
Hotel Multnomah, Portland, Ore.

September 12-15, 1955
Tractor Meeting and Production Forum
Hotel Schroeder, Milwaukee, Wis.

October 11-15, 1955
Aeronautic Meeting
Aircraft Production Forum, and Aircraft Engineering Display
Hotel Statler, Los Angeles, Calif.

October 31-November 2, 1955
Transportation Meeting
The Chase, St. Louis, Mo.

November 2-4, 1955
Diesel Engine Meeting
The Chase, St. Louis, Mo.

November 9-10, 1955
Fuels and Lubricants Meeting
The Bellevue-Stratford
Philadelphia, Pennsylvania

SAE Section Meetings . . .

Alberta—Jan. 20 and 21

Mural Room, Alsan Club. Dinner 7:00 p. m., meeting 8:00 p. m. North King Universal Transporter—Leslie Cahan, manager, North King Equipment (Canada) Ltd., Calgary.

Jan. 21—Friday morning, 10:00 a. m. a field demonstration of the Universal Transporter.

Atlanta—Jan. 28

Influence of Alexander Botts on Automotive Design, 1955 SAE President C. G. A. Rosen. Golden Anniversary Event.

Canadian—Jan. 19

Royal York Hotel, Toronto. Dinner 7:00 p. m. Air-Marshall W. A. Curtis, vice-chairman of the Board, A. V. Roe Co., Ltd., Malton, Ont. SAE Student Night.

Chicago—Jan. 24 and Feb. 8

South Bend Division, Jan. 24—Hotel LaSalle, Bronzewood Room, South Bend, Indiana. The Dart Propeller-Turbine Engine—C. M. Rice, project engineer, Rolls-Royce Dart Turboprop Engine, Aviation Gas Turbine Division, Westinghouse Electric Corp. Technical chairman will be Frank C. Mock, director, Fuel Systems Engrg., Bendix Products Div., Bendix Aviation Corp. South Bend, Ind. Presentation of 25 and 35 year membership certificates.

Feb. 8—Hotel Knickerbocker, Grand Ballroom, Chicago, Ill. Dinner 6:45 p. m., meeting 8:00 p. m. Tractors, Industrial Power & Diesel Engines. Special Feature—Social Half-Hour, 6:15 to 6:45 p. m.

Cleveland—Jan. 17

Manger Hotel, Cleveland. Dinner 6:30 p. m., meeting 7:45 p. m. Studies of Fretting Corrosion in the field of Lubrication—D. Godfrey and E. E. Bisson, NACA Lewis Flight Propulsion Lab., Cleveland Hopkins Airport. Colored movies will be shown.

Detroit—Jan. 24 and Feb. 7

Jan. 24—Small Auditorium, Rackham Educational Memorial. Meeting 8:00 p. m. Junior Group Meeting. Engine Development—Richard G. Abowd, Ethyl Corp., Robert F. Carlson, Ford Motor Co., Robert O. Williams, Packard Proving Grounds. Moderator, Charles R. Barbour, Ford Motor Co. Social Hour in Snack Grille following meeting.

Feb. 7—Large Auditorium, Rackham Educational Memorial. Dinner 6:30 p. m., meeting 8:00 p. m. The Greyhound Scenicruiser—Two Level Intercity Coach—F. A. Franklin, GMC Truck & Coach Division, General Motors Corp.

Indiana—Feb. 10

Indianapolis, Ind. Dinner 7:00 p. m., meeting 8:00 p. m. Observing Performance Characteristics of Excavating Machinery, J. H. Meier, research engineer, Bucyrus-Erie Co., South Milwaukee, Wis.

Metropolitan—Feb. 4 and 16

Feb. 4—Hotel New Yorker. Cocktails 6:00 p. m., dinner 7:00 p. m., Dancing 9:00 p. m. Golden Anniversary Party. C. G. A. Rosen, 1955 SAE President. Tickets: $10.00 per person.

Feb. 16—The Engineering Societies Bldg. (Fifth Floor) 29 West 39th St., New York City. Meeting 7:45 p. m. Symposium—Fuel Pumps—Representatives from American Bosch and Cummins Diesel Engine Co.

Mid-Continent—Jan. 21

Meeting to be held in Cushing, Oklahoma.

Mid-Michigan—Jan. 24

General Motors Institute Auditorium. Dinner 6:30 p. m., meeting 8:00 p. m. Pinwheels or Pistons—W. A. Turunen, head, Gas Turbine Dept., G. M. Research Division, General Motors Corp., G. M. Technical Center, Detroit 2, Mich. Display of G. M. Firebird Turbine.

Mohawk-Hudson—Feb. 7

Circle Inn, Latham, N. Y. Dinner 6:45 p. m., meeting 8:00 p. m. Nuclear Propulsion—Sherman Naymark, General Electric Co., Schenectady, New York.

Montreal—Jan. 17

Sheraton-Mount Royal Hotel. Dinner 7:00 p. m., meeting 7:45 p. m. Students' Night.

New England—Feb. 1

MIT Faculty Club. Dinner 6:45 p. m., meeting 8:00 p. m. Modern Earth Moving Equipment—Alan McClimon, manager, sales development, Euclid Road Machinery, Division of General Motors.

Philadelphia—Feb. 9

Engineers Club. Dinner 6:30 p. m., meeting 8:00 p. m. Greyhound Scenicruiser—F. A. Franklin, coach engineer, GMC Truck & Coach Division, Pontiac, Mich.

Pittsburgh—Jan. 25

Webster Hall—Mellon Institute. Dinner 6:00 p. m., meeting 8:00 p. m. Engine Design—Improvements of the Chrysler V8 Engine. Speaker from the Plymouth Division, Chrysler Motor Corp., Detroit, Mich.

Salt Lake—Feb. 8

Hotel Newhouse. Meeting 8:00 p. m. Transportation & Maintenance—E. C. Paige, Research Dept., Ethyl Corp., Detroit, Mich.

Southern California—Feb. 14

Rodger Young Auditorium. Dinner 6:30 p. m., meeting 8:00 p. m. Physiological Aspects of High Altitude Flight—Dr. Ulrich C. Luft, head of Physiology Dept., Lovelace Foundation, Albuquerque, New Mexico. Aeronautics meeting.

Southern New England—Jan. 25

Bradley Field, Windsor Locks. Dinner 6:45 p. m., meeting 8:00 p. m. This Fantastic Engineering Era—A. T. Colwell, vice-president, Thompson Products, Cleveland, Ohio. Golden Anniversary Meeting. Presentation of 25 and 35 year certificates.

Spokane-Intermountain—Feb. 10

Desert Caravan Inn. Dinner 7:00 p. m., meeting 8:00 p. m. E. C. Paige, Ethel Corp., Detroit, Michigan.

Syracuse—Feb. 10

Dinner 6:30 p. m., meeting 8:00 p. m. Conveyors That Pay Dividends—R. I. Hicks, president, Lamson Corp., Syracuse, N. Y.

Texas—Jan. 14 and Feb. 11

Aircraft Engines.

Feb. 11—Fuels and Lubricants.

Twin City—Feb. 9

Curtiss Hotel, Minneapolis. Dinner 6:45 p. m., meeting 8:00 p. m. Automotive Safety. Ladies Night.

Virginia—Jan. 26

Westover Room at William Byrd Hotel. Social half-hour 6:30 p. m., dinner 7:00 p. m., meeting 8:00 p. m. Influence of Alexander Botts on Automotive Design—1955 SAE President C. G. A. Rosen. Golden Anniversary Meeting.

Washington—Jan. 20

Occidental Restaurant. Dinner 7:00 p. m., meeting 8:00 p. m. What's New in 1955 Automobiles—Joseph Geschelin, Detroit Editor of Automotive Industries, Motor Age, and Commercial Car Journal. Member of SAE National Production Engineering Activity Committee. Chilton Automotive Publications. Detroit, Michigan.

Western Michigan—Jan. 18

Bill Stern's Steak House. Dinner 7:00 p. m., meeting 8:00 p. m. Chevrolet Paper on V-8 Engines—W. R. MacKenzie, engineering dept., Division of General Motors Corp., Detroit 2, Mich.

Wichita—Jan. 19

Broadview Hotel. Dinner 6:30 p. m., meeting 8:00 p. m. Oil Production in Asia—Richard Kerr, Arabian-American Oil Co., New York.

Williamsport—Feb. 7

Moose Club Auditorium. Dinner 6:45 p. m., meeting 8:00 p. m. Diesel Engine Design—Prof. P. H. Schweitzer, The Pennsylvania State University, State College, Pa.

News About Special Publications

Inside and outside of planes, things are getting hotter all the time. In fact the thermal barrier is taking over from the sound barrier as public enemy No. 1 of the sky.

Engineers, and materials men in particular, are making pretty good headway in their battle against heat. A series of papers being made available by the SAE Special Publications Department charts the latest progress in this "hot war." Included in this group are the following papers:

- "The Aerodynamic and Powerplant Heating Problem in High-Speed Aircraft," by M. R. Kinsler, North American Aircraft.
- "Thermal Limitations of Common Aircraft Materials," by C. S. Davis, Northrop Aircraft, Inc.
- "Some Trends in Elevated Temperature Resistant Airframe Materials," by C. W. Alesch, Convair.
- "Hot Sandwiches," by T. L. Burton, Douglas Aircraft.
- "High Temperature Problems Associated with the Use of Rubber Parts in Aircraft," by F. E. Clark, North American Aircraft.
- "Application of Metallic Materials for Aircraft Structures in the Temperature Range 600 to 1100 F," by J. W. Huffman, North American Aircraft.
- "Ceramic and Metal Protective Coatings for High Temperature Materials," by J. V. Long, Solar Aircraft.

These papers, part of a seminar on high-temperature materials for high-speed aircraft, held Dec. 6, 7, and 8 by the SAE Southern California Section, are available for 35¢ each to members, 60¢ each to nonmembers.

* * * * *

DID YOU KNOW THAT the SAE Special Publications Department makes available for distribution SAE meetings papers for one year from the time each is first produced?

After the year is up, generally the only way to get a paper is by ordering photostats of it. The charge for photostats (negatives) of papers is 50¢ per page. You can also order photostats of SAE Journal and Transactions pages at the same page rate.

* * * * *

World War II GI's used to hear that the Army spent more time and money on development of the GI shoe than any other item of equipment. **A look at the new SAE Seating Manual would probably convince you that the passenger car seat occupies the same distinction in the automotive family.**

We're sure this extensive treatise on seat construction will reveal a few "things you never knew before" about the subject, even if you are a body specialist. **Read this new treatise and you'll probably slip into your car seat with a new respect for the engineering that went into it.**

If you want a copy of the SAE Seating Manual, order it as SP-135 from the SAE Special Publications Department. It'll cost $2.00 if you're a member, $4.00 if you're not. The unit price is lower in quantity orders of 10 or more.

Proper Additives Give Fuel "New Look"

Based on paper by

D. P. BRENZ

Shell Oil Co.

EXTENSIVE investigations in several laboratories have shown that preignition or uncontrolled ignition is caused most frequently by deposits which are subject to modification by the composition of fuel or oil or both. The deposits contain carbon and certain lead salts. These salts act as catalysts to lower substantially the ignition temperature of the carbon. Under these conditions, deposits attain a sufficiently high temperature to burn and ignite the air/fuel mixture independently of the spark.

In the presence of certain phosphorus-containing compounds, different lead salts are formed which have much less effect upon the ignition temperature of carbon. Hence deposits have greater resistance to oxidation or burning. Conventional combustion chamber deposits burn or glow at 740 to 760 F, synthetic mixtures of lead salts and carbon ignite at a somewhat higher temperature, while pure carbon and phosphorus mixtures are relatively noncombustible, requiring 1200 and 1100 F, respectively, to burn. (Paper " 'New Look' in Motor Gasoline" was presented at SAE Baltimore Section, May 13, 1954. It is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

New Yardsticks Tell Facts About Deposits

Based on paper by

C. A. HALL
J. A. WARREN
and
J. D. McCULLOUGH

Ethyl Corp.

(Complete paper will appear in 1955 SAE Transactions.)

TEST procedures and special instrumentation have been developed for measuring the effects of combustion chamber deposits on deposit ignition. These laboratory and road test procedures have been found to correlate to give consistent directional results.

One procedure employs a newly developed multicylinder deposit-ignition counter which detects and counts uncontrolled deposit-ignited combustion in each cylinder. This device permits the effect of variations in engine design as well as gasoline, oils, and additives, to be evaluated both in the laboratory and on the road. These procedures have led to the following findings:

1—Refinery trends which increase the aromatics in gasolines, to secure higher antiknock quality, lead to the formation of combustion chamber deposits which have greater deposit-ignition tendencies. This trend places further emphasis on the need for better lubricating oils and/or special fuel additives.

2—The use of a commercial phosphorus fuel additive will reduce deposit ignition.

3—The new volatile multi-grade lubricating oils will reduce deposit ignition.

(Paper "Practical Yardsticks for Deposit Effects" was presented at SAE Summer Meeting, Atlantic City, June 10, 1954. It is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Engine Testing Requires Imagination

Based on paper by

A. E. CLEVELAND

Ford Motor Co.

SCIENTIFIC engine testing starts with establishing definite test objectives. When these have been determined, each test should be approached from at least three positions to reduce the chance of error. In the determination of optimum combustion chamber design, for example, one of the significant relationships is that between spark, fuel octane, and chamber shape.

Spark advance for optimum power provides a very usable index to the speed of combustion within the chamber. A chamber which requires a high spark advance for optimum power is probably a much slower burning and possibly less turbulent chamber than one with a lower minimum advance for best torque requirement. This, taken in connection with a study of the engine indicator diagram, can prove to be a valuable index to a test evaluation of chambers.

The measurement of the minimum spark advance for best torque (MET) is performed most efficiently on the dynamometer at either full or part throttle. The engine conditions of speed and load are established and the mechanical controls including the throttle position are fixed. The spark advance is then varied until optimum torque is indicated on the scale and the degrees of spark advance noted. This is repeated until a complete three-dimensional figure of speed and load and spark advance is developed.

There has been no other completely acceptable approach developed for this test to date, although we are working on an engine indicator correlation.

The compromise of torque loss for knock-free operation on all available fuels is a designer's option, balancing compression ratios and advance curves for any given combustion chamber.

The engine, equipped with test combustion chambers is tested first on the dynamometer. Spark advance and fuels are controlled for a given speed and load. Knock is held to reproducible borderline intensity with a known reference fuel, and the required spark advance is observed, providing a curve of spark advance versus octane number for each speed and load. Next, similar test is run, using a knock-free fuel and fixed speed and throttle position. The drop of torque is then noted as the spark is retarded or advanced from the optimum or MBT setting. This provides a companion curve of power loss versus spark setting to compare with the previously obtained curve of octane requirement versus spark setting.

A second set of observations of this relationship is provided by a series of road tests. Electronic instrumentation permits readings of spark advance under all conditions of speed and load from within the car. A manual control of the spark advance is made possible by means of a hydraulically operated control system connected to the distributor. Test fuels are carried in several containers and changeover from one test fuel to another reveals the octane requirements of the engine as it is operating under conditions of acceleration or of constant speed and load.

In practice, this evaluation is normally made under conditions of wide open throttle acceleration, from the lowest practical speed to above the speed of detonation, or at some part throttle accelerating condition established by a fixed throttle position or a fixed manifold vacuum. By varying spark advance and fuels to obtain the recognized constant of borderline knock, a speed versus spark curve is obtained for each octane number blend of isooctane and normal heptane.

These curves together form a frame-

work upon which any spark advance can be plotted to predict the resultant octane requirement for the engine under the normal operating load or fixed load accelerating conditions.

A third method of evaluating the relations of spark advance to fuel octane in the combustion chamber makes use of several known fuels, and the automatic distributor and carburetor as installed, providing they have been previously checked. The vehicle is accelerated at full throttle, or the desired part throttle position, and knock is bracketed with the control fuels. This test requires no special instrumentation and produces a practical and easily understood result. (Paper "From Art to Science in Engine Testing" was presented at SAE Western Michigan Section, Muskegon, March 16, 1954. It is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Short Trippers Gain From Multi-Grade Oils

Based on paper by

C. C. MOORE
W. L. KENT
and
W. P. LAKIN

Union Oil Co. of Cal.

MANY tests to determine the effect of viscosity on oil consumption have emphasized hot-and-running operation rather than stop-and-go conditions. This raised doubt as to the accuracy of data predicting oil consumption in average passenger car service.

To clarify this point, tests were carried out in privately owned cars using two multi-grade oils, 5W-20 and 10W-30, and two conventional oils in the 20 and 30 grades. Nineteen cars of seven different makes were used and there was no control over their operation.

The 5W-20 oil showed a 16% higher consumption than its 20 grade counterpart, while the 10W-30 showed essentially the same consumption as the 30 grade.

To establish the relationship between oil viscosity and consumption ratio data from this test was plotted against oil viscosities at several temperatures. The best correlation was obtained when the oil viscosities were taken at 250 F. Under typical passenger car operation a 20% change in oil consumption rate is produced by a change in oil viscosity of about 2 to 3 SUS at 250 F.

For over-the-road operation, the best temperature for correlation appears to be 300 F. And here the plot showed a 20% change in oil consumption ratio being produced by a change in oil viscosity of about 1½ to 2 SUS at 300 F.

Calculation of consumption ratios shows that in typical passenger car service the SAE 5W-20 oil is intermediate between SAE 10W and 20 grades, while the SAE 10W-30 oil gives only slightly higher consumption than SAE 30. In open road operation the absolute consumption of all oils is increased, but the relative consumption of multi-grade oils is improved.

Lube oil viscosity is of little or no importance in the wear problem, but what might be called the film strength properties are important. Satisfactory film strength can be obtained by certain additive combinations. Since additives rather than viscosity control valve train wear, multi-grade oils do not enjoy any particular advantage in this respect. (Paper "Multi-Grade Oils for Improved Performance" was presented at SAE National West Coast Meeting, Los Angeles, August 17, 1954. It is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers).

Based on Discussion . . .

L. Raymond,
Socony-Vacuum Oil Co., Inc.

We ascribe the better acceleration and performance, the smoother and quieter engine, commented upon by users of multi-grade oils, to the reduction in combustion chamber and spark plug deposits, with attendant benefits in volumetric and thermal efficiencies and improved ignition and combustion. Since fuel economy is known to suffer with engine deterioration, conversely fuel economy should be benefited by improvement in engine condition and performance. We believe these gains will not be limited to low temperature operation.

John Miller,
California Research Corp.

Although valve train wear is primarily a problem of metallurgy there is evidence that it can be reduced by proper compounding of lubricating oil.

Extensive experience with many types of oils shows that the viscosity is not a major factor in controlling engine wear, and that fluidity of an oil cannot be used, as it is by so many, as a criterion for wear protection.

F. I. L. Lawrence,
Kendall Refining Co.

In laboratory tests, using SAE 20 oil as a reference oil, we have found that 10W-30 containing V.I. improver is consumed at a relatively higher rate at low consumption levels, whereas at high consumption levels it acts like an SAE 20 oil. We found this also to happen in road test vehicles. At the present time we cannot advance any reasons for the relationships we have observed.

New Members Qualified

These applicants qualified for admission to the Society between November 10, 1954 and December 10, 1954. Grades of membership are: (M) Member; (A) Associate; (J) Junior.

Alberta Group

Clyde H. Reeves (A).

Atlanta Group

Leo Droughton, Jr. (M), Daniel J. Haughton (M), Paul A. Young (A).

Baltimore Section

Arthur A. Baxter (J), 2nd Lt. Loren Dean Gardner (J), William C. Roben (J).

Buffalo Section

Clement William Cowley (J), Charles C. Mellor, Jr. (J), Norman Charles Schlegel, Jr. (J).

Canadian Section

Guido Colm (M), Alfred James Coventry (M), Vernon Floyd Elliott (J), Iain A. Gibbons (J), James Kenneth Ronson (M), Buddy C. J. Sinclair (J).

Central Illinois Section

Parry Barnes, Jr. (J), Chalmer M. Cloyd (M), Robert E. Moore (A), Arthur S. Schutzer (J), 2nd Lt. Robert Eugene Stremmel (J).

Chicago Section

Roy O. Erickson (J), Philip Keith (M), John A. Lake (M), Richard H. Powell (A), Oliver Waller Scheflow (J), Raymond Randolph Snyder (J), Robert Daryl Straszheim (J).

Cincinnati Section

Kenneth H. White. (J).

Cleveland Section

John Gerald Greenough (J), Richard Joseph Kern (J), Charles R. Kilgore (J), Victor C. Schroeder, Jr. (J), Samuel Stein (M), Arthur E. Stukey (A), Clarence Edward Youngman (J).

Dayton Section

Herman L. Izor (J), Melvin S. Lantz (J), James Pearce Munroe (M), 2nd Lt. George Edward Thompson (J).

Detroit Section

Harry Vincent Arnberg (J), James E. Bair (J), Albert C. Belge (M), Michael C. Berkey (J), Paul D. Blystone (J), J. Lawrence Buell, Jr. (A), Joseph S. Bull (J), Forest O. Byrd (M), John T. Camden (J), George James Castle (A), Robert J. Chapman (J), Edward J. Chondzinski (M), Raymond Morris Cole (J), William Thaw Collins, Jr. (J), Wilbur Gordon Dallas, Jr. (J), Don El Roi Dodds (J), Gene G. Engel (J), Calvin G. Estes (J), Edward Hong Gong (J), Robert W. Hancock (M), William L. Harris (M), Olen W. Hart (M), Donald L. Heller (J), William O.

New Members Qualified

continued

Heyn (J), Charles T. Hoffman (J), Clayton Antone Huben (J), Robert Lincoln Hurd (J), John L. Jackson (M), Harold Burton Jones (J), John W. Keller (J), Robert P. Keller (J), George Raymond Lefevre (M), Horace H. Ligan (J), I. David Long, Jr. (J), William E. McCollough (J), Duncan McRae (M), William Paul Panny (J), Samuel G. Rae (A), John Lee Saffer (J), Charles Wesley Schwartz (J), Ray Welch Sevakis (M), Harold M. Shattuck (A), Ralph Edward Small, Sr. (M), Lyle B. Smith (J), James Donald Symons (J), Charles N. Tripp (J), Gordon Leslie Walker (A).

Hawaii Section

Harrie Edwin Hoxie, Jr. (A), Morito Tsutsumi (A).

Indiana Section

Henry K. Purnhagen (A), David K. Thomas (J).

Kansas City Section

Charles Stephen Koegel. (J).

Metropolitan Section

Daniel Berlin (M), Arthur F. Bleiweiss (M), Gregory Joseph Brandewiede (M), Otto H. Fedor (M), Owen E. Gilligan (A), William T. Gunn (M), Roy Harold Lindenlaub (J), Nils H. Lou (M), John Medwin (M), Ralph J. Opre (J), Edward T. Otte (A), Fred L. Tunis, Jr. (M), James A. Wilson (M).

Mid-Continent Section

Allen Horton Bassett (J), Edmund O. Schroeder (M).

Mid-Michigan Section

Dell J. Bramble (J), Robert Theodore Florine (J), Harold L. Fuss (J), Arthur T. Koster (J), Frank H. Walker (J).

Milwaukee Section

Roy B. Jarvela (A), Lloyd A. Keyser (J), George B. Luhman, Jr. (J), Lawrence J. Matthews (J), Glenn E. Poehls (J), Raul Aristide Stern (J).

Montreal Section

Robert B. Fullerton (M), Robert William Thompson (J).

New England Section

Horace C. Humphrey (A), Joseph J. Miliano (J), Francis Xavier Tuoti (J), David S. Vaughan (J).

Northern California Section

Gail Hugh Allison (A), Frank George Avitia (J), Ben M. Darrow (A), John

New Members Qualified

continued

W. Humfreville (A), Earl G. Koehler (M), John Kenneth Longmuir (M), Walter Mayer (J), Mortlock Stratton Pettit (M), Casper J. Szukalski, Jr. (J), M. Vane Wilks (M).

Northwest Section

Donald Duncan Laine (J).

Oregon Section

Richard William Boubel (J), H. Gordon Green (M), William E. MacDonald (J).

Philadelphia Section

Kenneth Frederick Becker (J), Harold Earl Beegle (M), Homer P. Coffin (J), J. Garrett Forsythe, Jr. (J), Albert Joseph Impink, Jr. (J), Thomas Harry Madden (J).

Pittsburgh Section

Jonathan T. Carriel (M), Robert Varga (J).

St. Louis Section

Cpl. Charles W. Ferguson (J), Thomas A. Fling (J), Murry C. Glick (M).

Salt Lake City Group

Prabhat G. Doshi (J), Hugh A. McLean (J).

San Diego Section

Duane Robert Prosser (J).

Southern California Section

Vernon C. Brown (M), Leslie M. Davis (A), Travis Page Eskridge (J), Frank Hetzel (J), Frank H. Holbrook (A), George Charles Kouris (J), Donald Richard Montgomery (J), Rodney K. Moore (J), Marvin A. Moss (J), Theodore C. Nark, Jr. (J), Virgil J. Palub (A), Loren A. Patrick (J), Alden P. Perry (J), Bert N. Svenson (M), Capt. Emil C. Wiener (M), Vernon R. Wills (A), William Albert Wilson (J).

Southern New England Section

David T. Feldman (J), Leo George Foxwell (J), Harold Russell Kunz (J), Peter G. Meyers (J), Clyde Vernon Stahle, Jr. (J), Donald Leonard Stapinski (J), George T. Velz (J).

Spokane-Intermountain Section

June Roberts (M).

Texas Section

Russell H. Biegel (M), Igor Alexei Black (M), Clarence Lee Curl (J), Daniel G. Gilmore (M), Ray Harrison Keasler (A), Harry I. Spiegel (M), Lawrence James Sullivan (J), Robert H. Sumner (J), Herbert Zinberg (M).

New Members Qualified

continued

Texas Gulf Coast Section

Robert E. Hefner (J), Melbourne M. Martin, Jr. (A).

Twin City Section

Edwin Frank Humpal, Jr. (J), Theron Wright (J), Gordon E. Harms (J).

Washington Section

Morton Schler (M), Edward S. Taub (A).

Western Michigan Section

Andrew J. Kozlowski (A), Gerald Lauril Larsen (J).

Williamsport Section

Arthur L. Altemose, Jr. (J).

Outside Section Territory

Walter Harold Bergler, Jr. (J), Louis E. Bothell (J), Louis P. Cosgrove (M), David J. Hlubek (J), Roger C. Jaqua (J), James Thomas McCarter (J), Sheridan Osborne (M), Donald Gerald Riecken (J), Robert W. Rosselle (J), William W. Seaton (J), Clyde S. Stearley (J), Ralph D. Steele (J), Wesley John Wankel (J), Clifford Henry Wells (J), Jack Wittcamp (J).

Foreign

Arthur Benda (M), Brazil; Werner Kahn (J), Brazil; Shiv Nath Koshal (M), India; Robert Allan Lane (J), England.

Applications Received

The applications for membership received between November 10, 1954 and December 10, 1954 are listed below.

Atlanta Group

Russell L. Chapman, James G. Sloan, J. L. Wimbish.

British Columbia Section

Walter G. Boyd, Harold A. Turnill.

Buffalo Section

Edward G. Dingman, John R. Utz.

Canadian Section

Warren T. Bryan, Harold C. Moody, John G. Pearson.

Applications Received

continued

Central Illinois Section

Raymond E. Andrews, Wallace S. Baker, Francis E. Cambron, Jack A. Drais, John G. Frantzreb, John H. Pritt, John G. Wellwood, John S. Young.

Chicago Section

Donald J. Ariano, Joe Berg, Edgar B. Fields, R. L. Gilmore, Jeremiah Halpin, Frank A. Kocian, John Liu, George C. Reynolds, Emil G. Stanley, William S. Wade.

Cleveland Section

Eugene Bahniuk, Arlen Stanley Kjelby, Eugene V. Zettle.

Colorado Group

Robert J. O'Connor.

Detroit Section

James S. Aitken, Harry C. Anderson, Lawrence J. Anderson, Frank Brady, Robert C. Brady, Robert A. Brunner, Carl B. Burnett, Thomas R. Cassel, Joseph E. Faggan, Philip L. Francis, Charles A. Gibson, Carl E. Granfors, Roy Haeusler, Robert T. Hall, Robert E. Heintz, Melvin F. House, Jr., James J. Hovorka, Maynard J. Isley, Norman E. Janke, Robert L. Jenkins, Glenn M. Jones, Frank A. Knopf, Jr., Keith F. Knorr, Axel W. Kogstrom, Jr., Walter H. Kremkow, Herbert F. Krug, Jr., Robert F. Les, Robert F. McLean, Frank L. Moncher, William N. Patrick, Burnet J. Powell, Ambrose J. Rock, Joseph Roth, Carleton B. Spencer, George R. South, Gerald F. Stofflet, George A. Stonex, Jordan H. Stover, III, Frank W. Szanto, LeGrand E. Terry, David W. Thompson, John J. Tierney, Frank M. Van Sickle, John F. Weber, William L. Weertman, Leonard J. Zang.

Indiana Section

Karl L. Kleimenhagen, Herman G. Riggs, Karl M. Sharp, Marvin Stohler.

Kansas City Section

Robert O. Ballou, Henry W. Wilson.

Metropolitan Section

Tallmadge Leslie Boyd, Stanley W. Burgess, Donald Davidson, Jr., Harry Epstein, Joseph P. Finelli, O. S. Grunden, G. Harold Klein, Charles H. Lance, Claude E. Vautin.

Mid-Continent Section

Don E. Welch.

Mid-Michigan Section

Joseph W. Arnett, Jr., Frederick E. Cole, Rolf J. Dutzmann, Robert N. Khouri, Ray Parker, Jr., Ray J. Wilcox.

Applications Received

continued

Milwaukee Section

Donald A. Anderson, R. L. Jaeschke, Carl H. Rasmussen.

Mohawk-Hudson Group

Bruce C. Barnes.

Montreal Section

Richard E. H. Berryman, Joseph N. Frenette, Frederick C. Purvis, Gerard S. Robbers.

New England Section

George A. Amet, Hugh D. Hardinger, Watson Logan, Jr., Howard B. Stapleton.

Northern California Section

Charles G. Cox, Bruce A. Robbins.

Oregon Section

Fred D. Fulton.

Philadelphia Section

Robert H. Blaker, Anton O. Melby.

Pittsburgh Section

Robert M. Elder.

St. Louis Section

Harley L. Boehl, Ralph B. Cornell.

San Diego Section

Donald A. Brownell, Stanley P. Compton, Robert H. Manley, H. J. van der Linde.

Southern California Section

Joseph Birchill, Thomas E. Depkovich, Leigh E. Dunn, Lisle D. Horton, R. W. Howell, William J. King, Warren F. Schnell, Jack Sinder, Leland M. Tate.

Southern New England Section

Allan K. Fink, Robert H. Wilkie.

Texas Section

Howard E. Bramm, Augustus C. Ludlam, Jr., C. L. Robinson, Hugh J. Stack, William G. Stanfield, Alonzo D. Tuttle.

Virginia Section

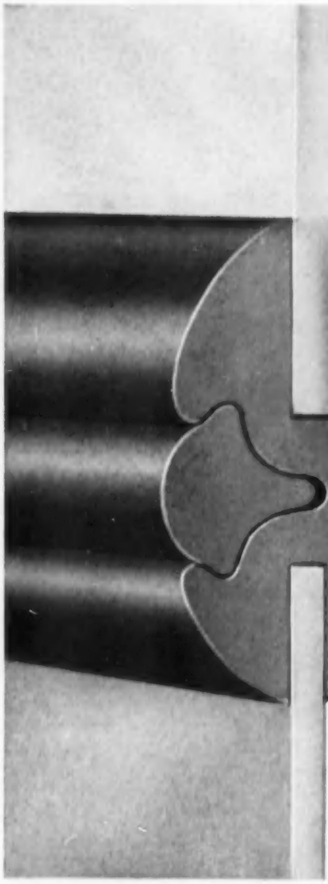
John W. Watkins.

Outside of Section Territory

Ira J. Barber, Theo. E. Deal, P. E. Hardy, Lewis Hall Helm, W. Cosby Hodges, Sanford S. Maremont, G. William Moody.

Foreign

Rodney E. Clarke, England; F. F. Van Quaethoven, Belgium.



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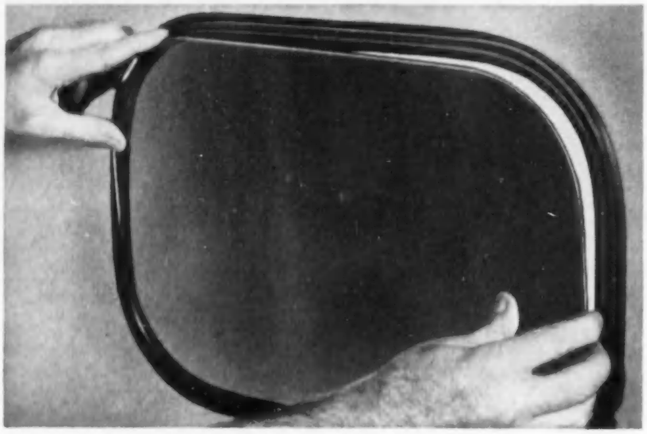

The filler strip makes possible these other Inland advantages!

LEAK PROOF! Permanently leak proof, because it seals both glass and body panel under powerful compression.

EASY GLASS REPLACEMENT! Less lost time for vehicles—broken glass can even be replaced on the road, if necessary.

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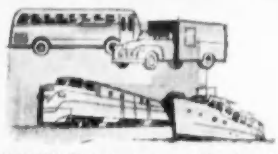

VERSATILITY! Ideal for vehicles, booths, trains, gasoline pumps, buildings, marine windows—for positive, permanent sealing of any window or panel!

No cement, clamps, frames or binders are needed to install windows using Inland Self-Sealing Weather Strip. It's an easy, one-man job. The filler strip, which enables the installer to compress the sealing strip *after* the glass is in place, eliminates all the headaches of trying to force *the glass* into a compressed groove. The filler strip, *a patented Inland feature*, makes this the easiest weather strip to install!

INLAND MANUFACTURING DIVISION
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Self-Sealing **WEATHER STRIP**


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This new name CLARK-TORCON offers specific and basic advantages to users of torque converters
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Big and "little" friends: 26,000 and 10,000 lb. trucks

Save more money by handling **bigger** loads

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The Clark-Ross Y-260 will handle bigger outdoor loads than any other lift truck, and it will go places where no other lift truck can travel! This truck is big enough to handle jobs which formerly required a crane and operator, hook man and trucker. It has the utmost traction and flotation—huge 14.00 x 20 tires are standard front and rear, with excellent weight distribution and 9 in. minimum underclearance. Its 17½ ft. turning radius permits it to be used in yards laid out for smaller trucks.

This Y-260 is *built* for 26,000 lbs. (at 36 inches)—not just beefed-up. It's as easy to drive as a truck half its size; power steering and power brakes are standard. And a brake selection switch enables the driver to apply brakes to *either* drive wheel, when one wheel has lost traction in slippery grounds. Maintenance access is excellent, wrap-around counterweight has minimum over-hang, operator visibility is outstanding. In general, *this lift truck is a beautiful brute!*

For big jobs, you'll want more details on the Y-260. Call your local Clark dealer, listed in the Yellow Pages under "Trucks, Industrial."

CLARK EQUIPMENT

Industrial Truck Division, CLARK EQUIPMENT COMPANY, Battle Creek, Michigan


Alcoa salutes S.A.E. on 50 years of progress
we've been proud to share
We'll say it in person—and show you our newest automotive applications of Alcoa® Aluminum—at the S.A.E. Golden Anniversary Annual Meeting. Join us at . . .
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Inside look at a safe overhaul!

NOW resilient Nylon inserts guarantee even better performance and extra reusability on all ESNA "blind" fasteners

ELASTIC STOP® nuts are specified for their proven self-locking, vibration-proof characteristics. But—air frames must also be designed with simple disassembly and economical overhaul in mind. And fixed fasteners must provide a safe margin of locking torque even though re-used again and again. Nylon inserts won't wear out. Bolt threads enter smoothly into the plastic locking collar, guaranteeing the narrow range of torque "scatter" ideal for power-tooled assembly lines. And for re-assembly any AN quality bolt can be used interchangeably . . . safely . . . when ESNA nylon inserts are on the "blind" fastener. The result . . . safer, simpler, low-cost maintenance procedures.

Nylon insert Elastic Stop nuts also provide:

- immediate identification during production or in the field.
- positive thread sealing and vibration-proof resistance to loosening.
- non-galling locking action that protects bolt threads against stripping and seizure.
- inertness to most common organic chemicals, oils, fuels and fungus growths.
- locking device adaptability to special aircraft fastener design requirements and productibility through a wide size range from 0-80 to over 2".

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Please send me the following fastening information:

☐ ESNA's New Nylon Specification Sheet

☐ Here is a drawing of our product. What fastener would you suggest?

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Faster work cycles, more work...

Contractors demand equipment with a Fuller torque converter coupling

Two workhorses in construction equipped with Fuller Torque Converter Couplings: Hough Model HM PAYLOADER (above), Pettibone Mulliken SPEEDALL, Front End Loader (right).

The performance of Fuller Torque Converter Couplings has been instrumental in helping contractors win the battle of competition, meeting contract deadlines, and offsetting rising costs of operation.

Here's *why* contractors demand Fuller Torque Converter Couplings. Torque demand is matched to the load through 2.1:1 torque multiplication, and the converter automatically returns to smooth, economical fluid coupling operation as load demand drops. Operators can crowd the load at all times without engine lugging or stalling . . . getting faster work cycles, more production every shift. The fluid cushions out shock loads . . . saves engines, transmissions, drive lines, axles, brakes and tires . . . reduces maintenance expense.

If you are looking for equipment that offers *profit-plus performance* . . . look for equipment with a Fuller Torque Converter Coupling installed as the power transmission component. Write for descriptive folder.

The following equipment manfacturers offer Fuller Torque Converter Couplings in their equipment.

The Frank G. Hough Co.
PAYLOADERS

Contractors Machinery Co., Inc.
TROJAN LOADSTERS

Austin-Western Company
SELF PROPELLED CRANE

The Buda Co.
TRACTORS & SHOP MULES

Jaeger Machine Co.
LOAD-PLUS LOADERS

The Gerlinger Carrier Co.
FORK LIFT TRUCKS

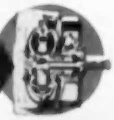
Pettibone Mulliken Corp.
SPEEDALL & SPEEDSWING LOADERS

Plymouth Locomotive Div. F-R-H
INDUSTRIAL LOCOMOTIVES

Unit Crane & Shovel Co.
TRUCK CRANES

Transo Div., LeRoi Co.
TLF LOADERS

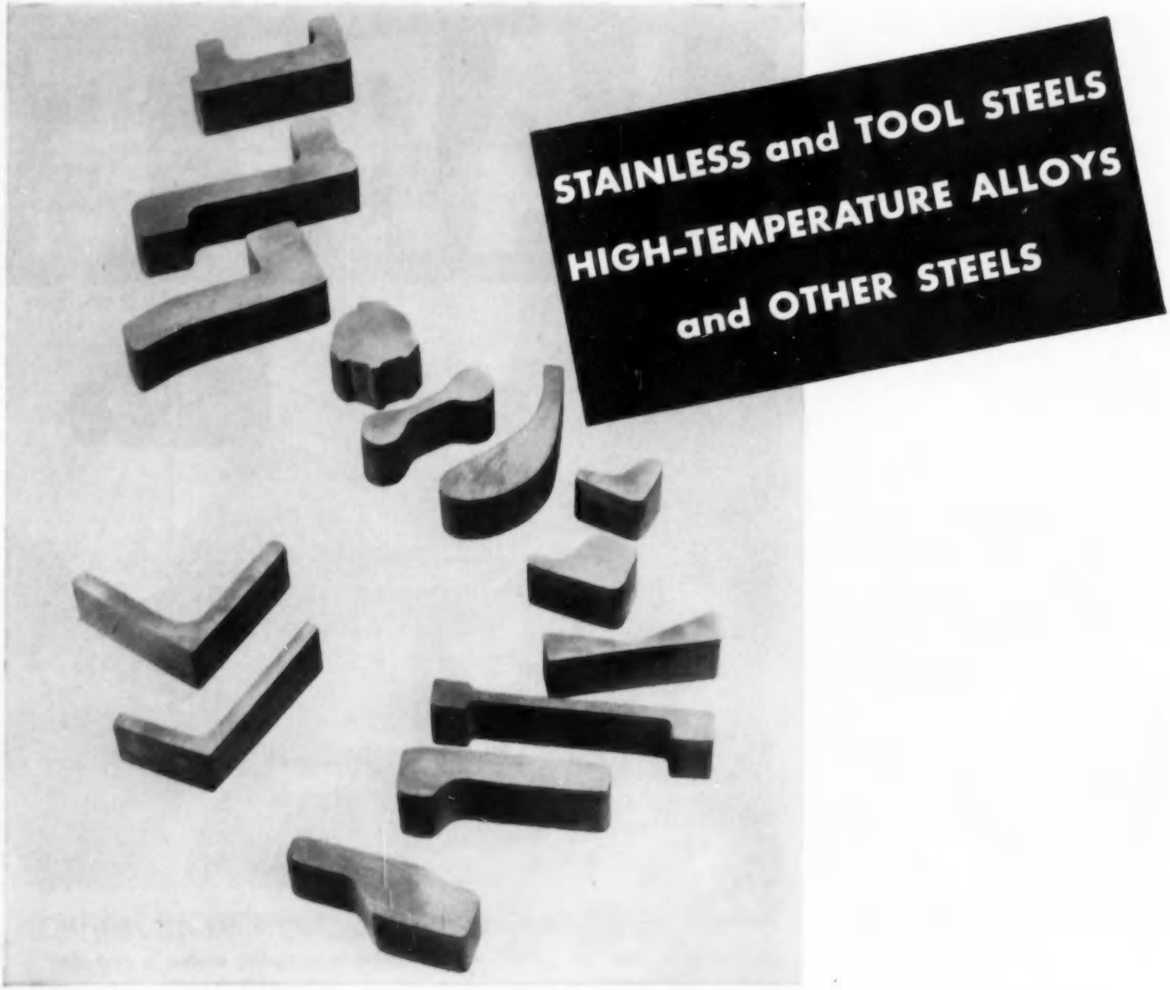
where torque really goes to work



Fuller TRANSMISSIONS ®

FULLER MANUFACTURING COMPANY (Transmission Division), KALAMAZOO, MICHIGAN

Unit Drop Forge Division, Milwaukee 1, Wisc. • Shuler Axle Co., Louisville, Ky. (Subsidiary) • Western Dist. Branch (Sales & Service, All Products), 641 E. 10th St., Oakland 6, Cal.



A-L HOT EXTRUSIONS (solid and hollow) may solve problems for you

Where can these leading advantages of hot-extruded special alloy steels apply to your production?

1. Hot extrusions require very little finishing before use, even in the case of involved shapes. The scrap loss is small and you can buy raw materials closer to finish size. You buy less high-cost steel, cut away less of it . . . save both in time and material cost.

2. The range of shapes, solid or hollow, which can be hot-extruded is almost infinite. They can be easily and quickly produced in any quantity. Dies for new or experimental parts cost little and can be made up fast.

● We're ready to serve your needs with hot extrusions in any grade of stainless or high temperature steel, many tool steel grades and other steels. Call us in to help. *Allegheny Ludlum Steel Corporation, Oliver Building., Pittsburgh 22, Pennsylvania.*

Help! (Dept. SA-61)

We have a parts problem that hot extrusions might solve. Let's see an AL representative for facts and figures.

- ☐ STAINLESS STEEL
- ☐ TOOL STEEL
- ☐ HIGH TEMPERATURE STEEL
- ☐ OTHER STEELS

Name__________

Company__________

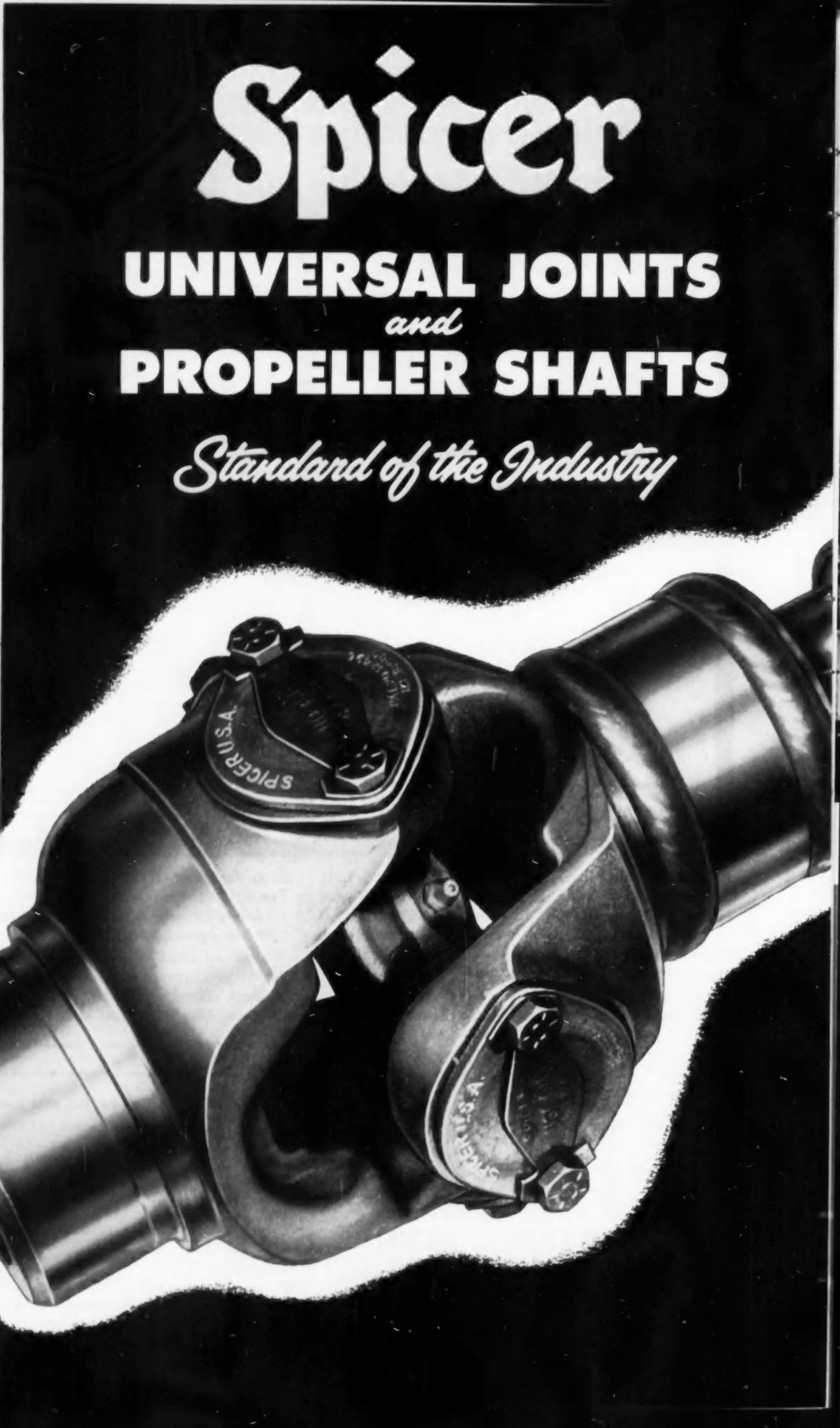
Address__________

Leading Producer-High Alloy Steels

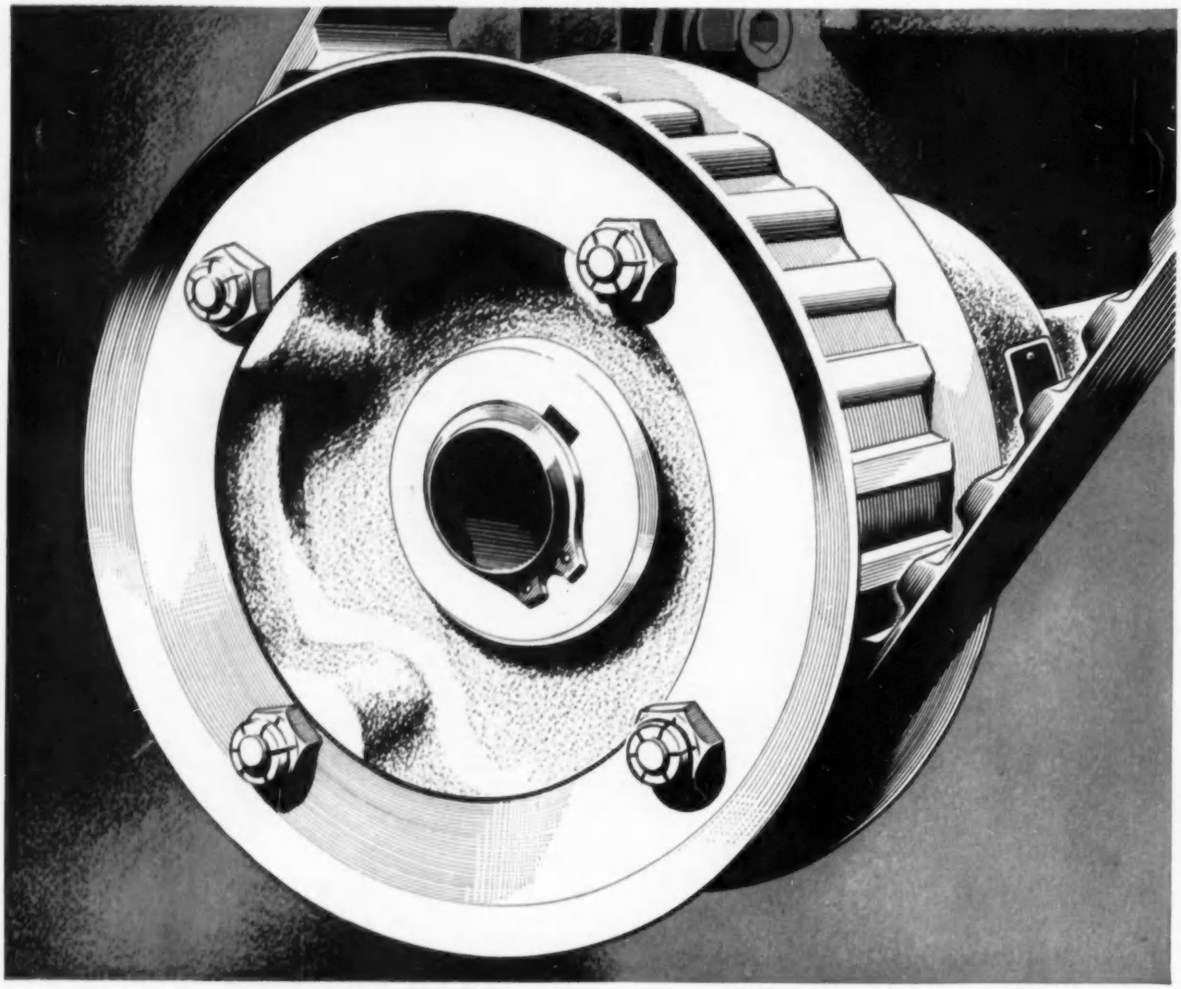
Allegheny Ludlum

AL ® TIME-TESTED STAINLESS STEEL

W&D 5310


Spicer
UNIVERSAL JOINTS
and
PROPELLER SHAFTS
Standard of the Industry
SPICER U.S.A.

FLEXLOC AT WORK



MORE AND MORE FLEXLOC LOCKNUTS are being used to hold assemblies like this one together. This modern timing belt drive combines the flexibility of a steel cable belt with the positive action of a silent chain drive permitting its use at speeds up to 15,000 rpm.

FLEXLOC Self-Locking Nuts offer the same positive action as the drive. Once the locking threads are fully engaged, the nuts won't work loose, regardless of the vibration encountered. And FLEXLOCS are reusable.

FLEXLOCS are available in a wide range of sizes in any quantity. Stocks are carried by leading industrial distributors everywhere. Write for Bulletin 866 and samples for test purposes. STANDARD PRESSED STEEL CO., Jenkintown 55, Pa.

DO YOU KNOW? Standard FLEXLOCS clean rough threads on bolts, and make them even better. The locking threads on all-metal FLEXLOCS are not chewed up when used on rough bolts.

Standard FLEXLOCS lock securely on bolts varying in diameter tolerances. The all-metal, resilient locking sections of the nut accommodate themselves to the diameter tolerances.

Standard FLEXLOCS are one piece, all metal. They are not affected by temperatures to 550°F. Nuts lacking these features have a more restricted temperature range.

Standard FLEXLOCS lock securely—stopped or seated—when 1½ threads of a standard bolt are past the top of the nut.

Standard FLEXLOCS are not affected by moisture, oil, dirt or grit. They lock efficiently under all conditions, regardless of the vibration encountered.

FLEXLOC®

LOCKNUT DIVISION

SPS

JENKINTOWN PENNSYLVANIA

performance records!

leather oil seal ever made!

-Torc

TRADE MARK

SEALS

This is in sharp contrast with present-day leather seals which tend to saturate and leak, or completely rubber-impregnated leather seals (Figure 2) which are impervious to oil and can neither absorb nor store lubricant for periods when lubricant is not otherwise supplied.

TESTS SHOW SUPERIORITY

In a continuing series of identical 1,000 hour tests at National Motor Bearing Co., the marked superiority of National Micro-Torc Oil Seals over present day leather seals has been clearly demonstrated. Completely rubber-impregnated seals showed an average leakage of 1 to 5 grams per day. In addition, these seals hardened and became brittle after only 200 hours operation at 170° F.

By contrast, 90% of Micro-Torc seals tested *had no measurable leakage at all.* (Figure 3) Test conditions throughout the 1,000 hours were identical in every respect. At the end of the run, *every National Micro-Torc Seal was flexible and fully operative.*

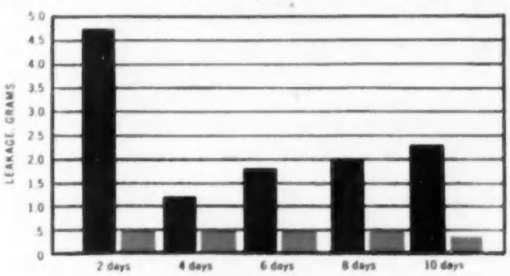


Figure 3

Zero-leakage performance of National Micro-Torc seals
in comparison with rubber-impregnated leather seals

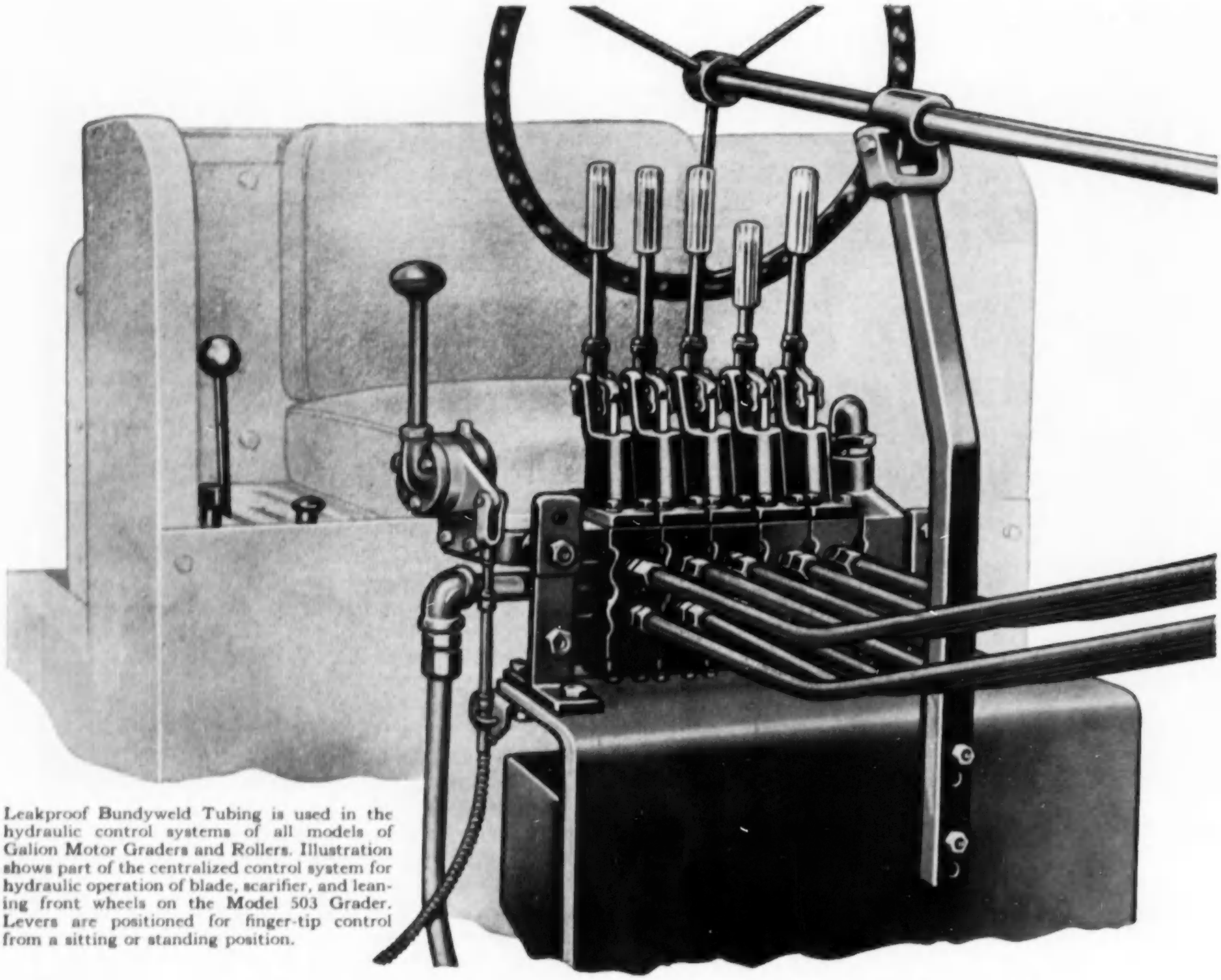
TECHNICAL BULLETIN

Describes National Micro-Torc in detail, contains test results, performance charts. For your free copy, write Dept. C

NATIONAL
OIL & GREASE SEALS
O-RINGS SHIMS
Approved original equipment for all cars, trucks, buses and tractors

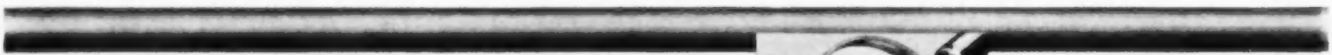
NATIONAL MOTOR BEARING CO., INC.
General Offices: Redwood City, Calif.
Plants: Redwood City, Calif.; Van Wert, Ohio


FELT FOR SEALS...
FELT FOR VIBRATION ABSORPTION...
FELT WICKING AND LUBRICATION...

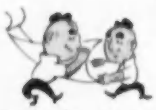


Leakproof Bundyweld Tubing is used in the hydraulic control systems of all models of Galion Motor Graders and Rollers. Illustration shows part of the centralized control system for hydraulic operation of blade, scarifier, and leaning front wheels on the Model 503 Grader. Levers are positioned for finger-tip control from a sitting or standing position.

Hydraulic systems of Galion graders depend on Bundyweld

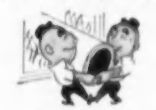


WHY BUNDYWELD IS BETTER TUBING



Bundyweld starts as a single strip of copper-coated steel. Then it's . . .

continuously rolled twice around laterally into a tube of uniform thickness, and



passed through a furnace. Copper coating fuses with steel. Result . . .

Bundyweld, double-walled and brazed through 360° of wall contact.

←

NOTE the exclusive Bundy-developed beveled edges, which afford a smoother joint, absence of bead and less chance for any leakage.

Use AEROQUIP 617 LIGHTWEIGHT AIR FRAME HOSE For Fuel And Oil Lines

The Navy's newest jet fighter, the Grumman F9F-9, is one of the world's few combat planes capable of supersonic speeds in level flight.

Important savings in weight were achieved by using Aeroquip 617 lightweight air frame hose instead of conventional types for fuel and oil lines.

Aeroquip 617 hose is recommended for use with lubricating oils made to specification MIL-L-7808 as well as petroleum products. Complete technical information is given in Aircraft Engineering Bulletin AEB-2 . . . please write for it.

Aeroquip

REG. TRADE MARK

AEROQUIP CORPORATION, JACKSON, MICHIGAN
AERO-COUPLING CORPORATION, BURBANK, CALIFORNIA
(A Subsidiary of Aeroquip Corporation)

Manufacturers of Aeroquip Flexible Hose Lines with detachable, reusable Fittings; Self-Sealing Couplings; Brazed Aluminum Elbows
LOCAL REPRESENTATIVES IN PRINCIPAL CITIES IN U.S.A. AND ABROAD • AEROQUIP PRODUCTS ARE FULLY PROTECTED BY PATENTS IN U.S.A. AND ABROAD

+ INDEX TO ADVERTISERS +

Uniform high quality is the first requirement in automotive cable and cable assemblies. Packard cable *exceeds* SAE specifications, and meets or exceeds the high standards of automotive manufacturers. But Packard's advantages go beyond quality itself. Dependable, on-time delivery that results from flexible, carefully maintained production schedules is one of many additional benefits you enjoy when you deal with Packard.

Consider Packard as a source

When you choose Packard Electric as a source you acquire the services of an expert team that is familiar with all phases of the cable business. A daily production capacity of 7,000,000 feet of cable and more than 800,000 wiring assemblies assures unfailing delivery. And Packard's large staff of experienced engineers is at your service for expert counseling and advice at any stage of a job. In the past, benefits like these have meant big savings to many Packard customers. More than likely, they will mean the same to you.

GM GENERAL MOTORS

Packard REG. U.S. PAT. OFF.

Packard Electric Division, General Motors, Warren, Ohio
Offices in Detroit, Chicago, and Oakland, California

AVIATION, AUTOMOTIVE AND APPLIANCE WIRING


50,000,000
cars mean over a
Billion Felt Parts!
These General Motors Felt Standards were the first felt specifications to be written. Their successful development in 1920 was a part of the GM program aimed at improving the quality and performance of GM products. GM wanted to know what felt could do, how it could help make cars better, whether felt quality could be controlled. American Felt was given the privilege of collaboration. Together we studied what types of felt were most suitable for each application, and what new uses could be developed. As a result, GM was able to standardize its felts. This benefited not only GM and American, and the felt industry, but the automotive field as well, because the GM Standards later became the basis for the S.A.E. Felt Standards.
Today there are over 80 felt parts in an automobile, and others in trucks, tractors, home electric plants, washing machines, and so on. Felt wicks supply oil; felt seals retain lubricants, filter out foreign particles and water; felt channels guide and protect windows; felt prevents chafing noises and rattles. In many unseen ways, GM standard felts serve us all. The specifications first developed in 1920 are still used daily, still guide designers, engineers, and purchasing personnel, making it possible for felt to be selected, specified with care, and bought with as much accuracy and assurance as any other engineered material.
Many factors entered into the design and production of cars so good that 50 million have been made by GM to meet public demand. Standardized felt is but one. American, and the felt industry as a whole, is glad to contribute to the economy, safety, reliability and comfort of General Motors cars.
American Felt Company
TRADE MARK ®
GENERAL OFFICES: P. O. BOX #5, GLENVILLE, CONNECTICUT. SALES OFFICES: New York, Boston, Chicago, Detroit, Cleveland, Rochester, Philadelphia, St. Louis, Atlanta, Dallas, San Francisco, Los Angeles, Portland, Seattle, Montreal. — PLANTS: Glenville, Conn.; Franklin, Mass.; Newburgh, N. Y.; Detroit, Mich.; Westerly, R. I. — ENGINEERING AND RESEARCH LABORATORIES: Glenville, Conn.
GENERAL MOTORS STANDARDS
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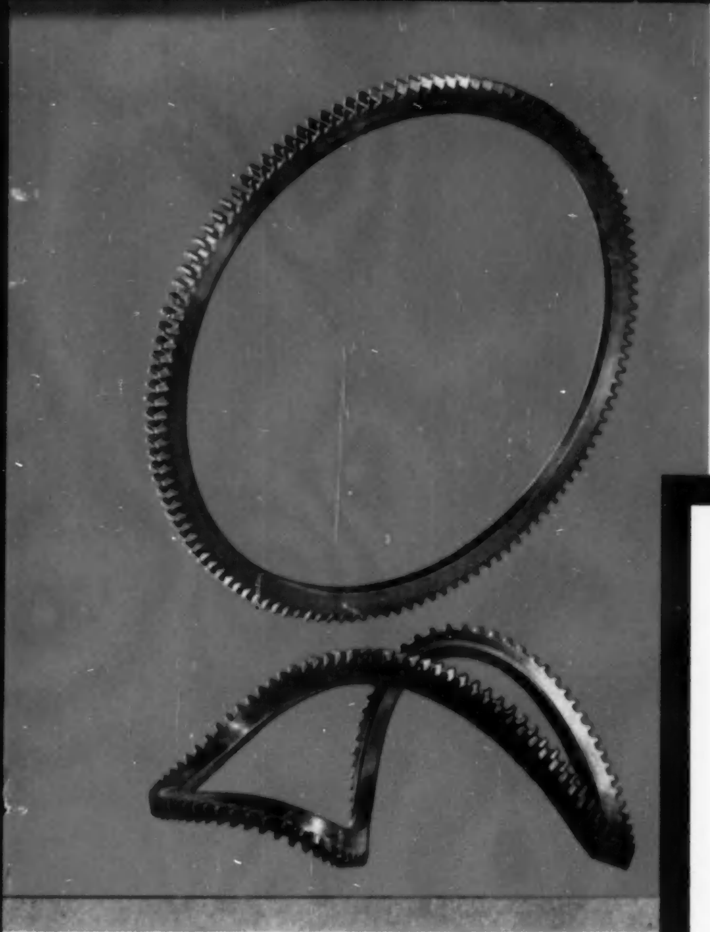
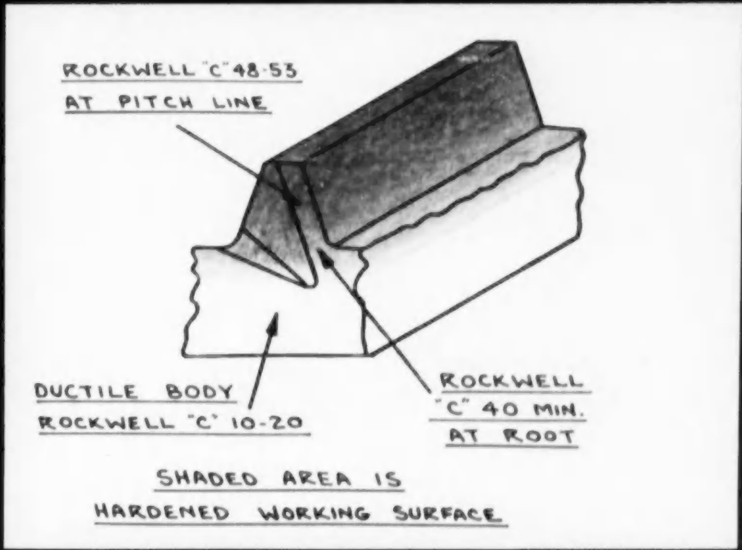
THIN! TOUGH! ...and "tender-hearted"





THE MANUFACTURE of flywheel ring gears poses special problems. Sectional thickness is usually less than three-quarters of an inch. To withstand the impact force of the starter pinion, the gear teeth must be hard. But the gear body itself should be unhardened so that it will conform tightly to the flywheel, and "give" under the stress that might snap a brittle gear.

Note how DOUBLE DIAMONDS are made to be thin, tough, "tender-hearted." The above photo of a gear twisted into a pretzel shape graphically demonstrates ductility. The sketch at right shows three important areas: the wide and deep hardness pattern, the generous area of transition, and the ductile body. These extremes are achieved in DOUBLE DIAMOND Flywheel Ring Gears by controlled selective heat treatment—all essential to flywheel ring gears that provide the best possible performance.

Our Engineering Department will be glad to make constructive suggestions on the design of flywheel ring gears, or on the many other types in which we specialize. Write, phone or wire—depending on the urgency of your need.

DOUBLE DIAMOND GEARS

FOR AUTOMOTIVE, FARM EQUIPMENT AND GENERAL INDUSTRIAL APPLICATIONS
GEAR-MAKERS TO LEADING MANUFACTURERS

Automotive Gear Works, inc.

ESTABLISHED IN 1914 RICHMOND, INDIANA